ACTIVITY 4-5: **WATER AT WORK (TURBINES)**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▹ construct a simple turbine.
- ▹ explain the role water plays in producing hydroelectric power.

MATERIALS:	
15-9oz plastic cups	15-30 cm lengths of string
30 pencils	15-50 cm lengths of string
30 scissors	15-2 liter plastic bottles
15 large nails	optional: garden hose

BACKGROUND INFORMATION:

The Greek philosopher Thales (600 B.C.) knew that when amber was rubbed with cloth, it attracted bits of straw or hair. The word electricity comes from the Latin word *electrum*, which means amber. The word *electrum* comes from a Greek word that means *shining*. Electricity is the energy associated with electrons that have moved from one place to another. Electric energy is measured by the flow of electrons. The greater the number of electrons, the higher the electric current.

There is tremendous power in moving water. Since ancient times, people have used that power to turn mill wheels. By the late 1800's, most water mills had been replaced by steam engines. But with the invention of the electric light bulb in 1879, water power became important once again as a means of generating electricity.

The mechanical energy (energy associated with motion) in falling or flowing water is used to generate usable electricity in a hydroelectric power plant. Hydroelectric means "using water to produce electricity." At a hydroelectric plant, dams hold back millions of tons of water. Some of the water is allowed to pass through pipes and is then channeled past turbines within the plant. The rushing water spins the blades of turbine in an electric generator to produce electricity. The spinning turbine causes large electromagnets to turn. The spinning electromagnets generates electricity.

PROCEDURE:

1. Students will be making a water turbine using a 9 ounce plastic cup and string. Students should work in groups of 2.
2. Each group should obtain **two** 9 ounce plastic cups.
3. Students need to use Student Activity Sheet 4-5 to construct their turbines.
4. Instructors may need to demonstrate how to tie knots and how to make slanted holes in the bottom of the plastic cup.
5. Testing the water turbines should be done outside.

DISCUSSION QUESTIONS:

1. What causes the plastic cup to turn as water leaves the bottle?
2. What makes the turbines turn faster? slower?
3. Where have you seen turbines in action?
4. Discussion of how turbines can do work. (Work = force x distance)
5. How are turbines are used in the making of electricity?
   (hydroelectric power)

ACTIVITY 4-6: **MAKING ELECTROMAGNETS**

OBJECTIVE(s): After completing the activity, students will be able to:

- observe that introducing electricity into a coil of wire will produce a magnet.
- identify the relationship between a turbine, a coil and a magnet in the production in hydroelectric power.

MATERIALS:	
30 large nails	**(OPTIONAL):** aluminum foil
30 D cell batteries	30-3.2 volts bulbs
30-150 cm lengths of 22 gauge insulated wire	masking tape-2 1/2"
1 wire stripper	30 scissors
30 wooden clothespins	
2 rolls of electrician tape (black)	
30 washers/1 box of paper clips	

BACKGROUND INFORMATION:

The relationship between electricity and magnetism is called electromagnetism. Powerful temporary magnets called electromagnets can be made by wrapping a coil of wire around an iron core (such as a nail) and passing an electric current through the wire. Whenever an electron moves (current), it has an associated magnetic field. As electricity moves around a coil, it creates a magnetic field through the coil. The strength of an electromagnet can be increase by increasing the number of loops of wire around the iron core. An important property of an electromagnet is that it can be made to lose and then regain its magnetic properties by turning the current off and on.

PROCEDURE:

1. In this activity, students will be making their own electromagnets with a large nail, D cell battery, and insulated wire.
2. Students should work in groups of 2, but each will make their own electromagnet.
3. Students need to begin by wrapping the insulated wire around the nail. It is important that they follow the directions on Student Activity Sheet 4-6 carefully. Instructors will probably want to demonstrate the proper technique for wrapping the wire around the nail. It is necessary to allow for a long lead (8 cm) for connection to the battery.
4. Students should follow the directions on Student Activity Sheet 4-6 to complete this activity.
5. Instructors should demonstrate how to tape the wooden clothes pin to the battery.
6. If time permits, give each student a small bulb and challenge them to light the bulb using their electromagnets.

DISCUSSION QUESTIONS:

1. Where have you seen electromagnets used before?
   (Hint: junk yard)
2. Would a permanent magnet work in a junk yard?

DAY 10

ACTIVITY 10-1: **BOAT CONSTRUCTION/RACES**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▹ construct a boat that will sail down the stream using wind and water current power.

MATERIALS:	
30-gallon Zip lock bags	30 small balls of clay
60 sheets white paper (8 1/2" x 11")	5 rolls clear tape
30 milk cartons	string
120 clear, plastic straws	30 scissors
2 boxes medium paper clips	plastic container for lottery
2 stop watches	30 Certificates
Prizes	5 meter sticks

PROCEDURE:

1. In this activity, students will construct and sail a milk carton boat over a designated course.
2. Students will each made their own boats.

ACTIVITY 10-2: **KITES**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▹ construct a simple sled kite.

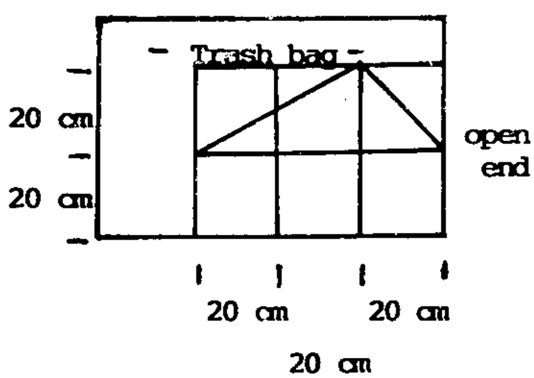
MATERIALS:	
30-3/16" wood dowels	30 rolls of kite strings
5 rolls of electrician tape	scissors
30 popsicle/craft sticks	Exacto knife
Kite pattern	1 box large garbage bags

PROCEDURE:

1. In this activity, students will be making a kite and flying it.
2. Students will work individually. (Instructors should be paired with 5-6 students for assistance.)
3. Instructors should hand out materials and go over rules for flying. Designated area should also be mentioned.

4. Materials needed for 1 kite:
    1 - 24" x 30" (61 cm x 76 cm) heavy duty trash bag
    2 - 3/16 x 24" (4 mm x 61 mm) dowels (struts)
    72" (183 cm) flying line (bridle should be 3 times kite length)
    Electricians' tape
5. To make kite, draw half of kite on unopened bag and cut out sail. Open kite.
6. Tape dowel to kite. Then tie bridle to bridge points.
7. Find center of bridle by placing keels together. Tie a loop in the mid-point of the bridle. Attach the flying line to this point.
8. Slit a popsicle stick at both ends and place it between the bridle lines to stop them from twisting.
9. Add a tail if weather conditions require.

A.



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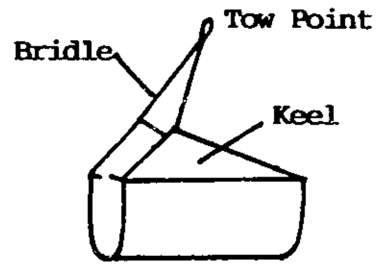

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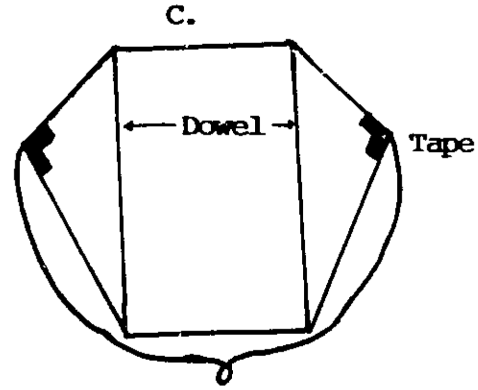

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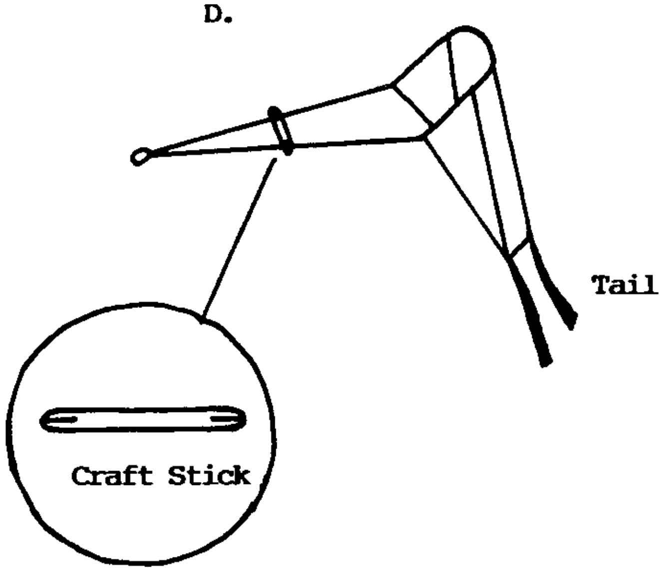
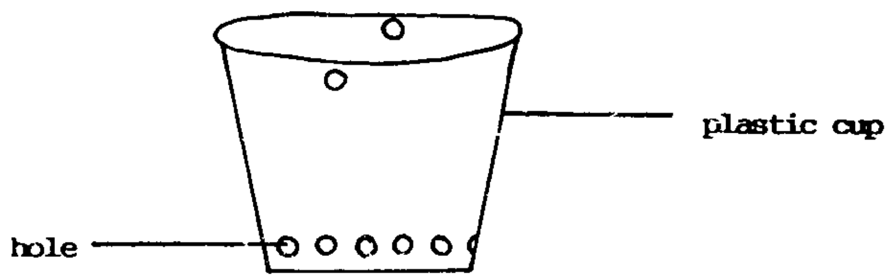


Student Activity Sheet 4-5

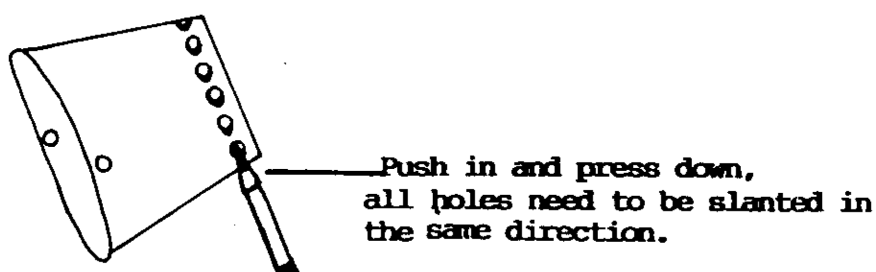
WATER AT WORK-TURBINES

1. Obtain a 9 ounce plastic cup, a 2 liter plastic bottle, a nail, and a scissors.

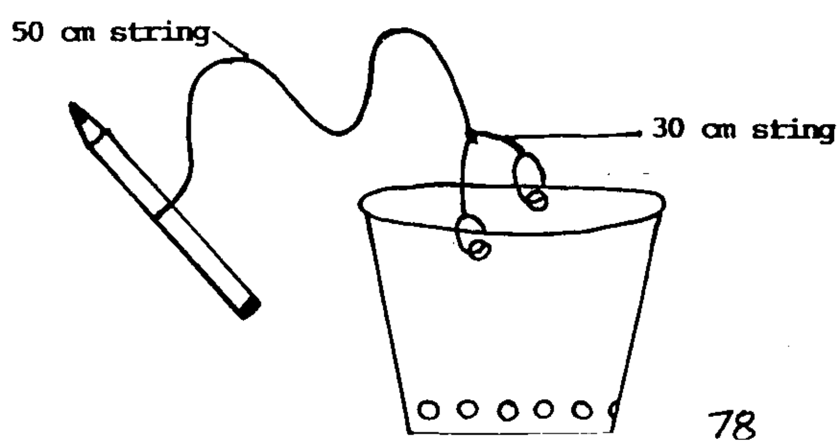
2. Using your scissors, place 8 holes in the side of the cup near the bottom. Make sure that they are spaced evenly around the cup. Also make 2 holes on the top of the cup, one on each side.



3. Lay your plastic cup on its side. Then push the point of your pencil into each hole on the bottom of the cup. Press the pencil down until it touches the side of the cup. **(Watch instructor demonstration)**



4. Tie the ends of the 30 cm string to holes on the top of the cup. Tie the 50 cm string to the middle of the 30 cm string. Tie the other end of the 50 cm string to the middle of your pencil.



5. Now its time to test your turbine. Obtain a 2 liter plastic bottle and fill it with water. Take your turbine and the bottle of water outside. As one person holds the turbine by the pencil, the other person should pour all the water into the turbine. **What do you observe?**

6. How can you make the turbine spin faster?

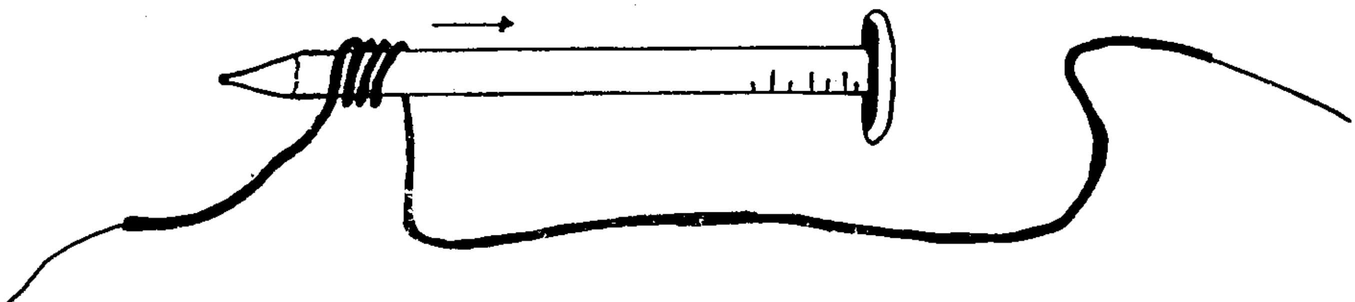
7. Where have you seen turbines in action?

Student Activity Sheet 4-6

MAKING ELECTROMAGNETS

1. Obtain a large nail and a piece of insulated wire.

2. Beginning at the point of the nail, wind your insulated wire, **tightly** and **evenly** down to the head of the nail, then back to the point. Be sure to start wrapping at the 8 cm mark you made. (**See instructor demonstration**)



3. Obtain a D cell battery, a clothespin and a piece of electrician tape. Clamp your electromagnet to the clothespin and tape the clothespin to your D cell battery. (**See instructor demonstration**)

4. Experiment with your electromagnet to see how many washers/paper clips you can lift.

5. Explain how you used your electromagnet to pick up and release the washer and paper clips.

6. Do you think your electromagnet is a permanent or a temporary magnet? Explain why you think so.

DAY 9 **TEACHER NOTES**

Estimation Game: Estimate the number of major dams on the Columbia River. There are 59 major dams on the Columbia River: 31 Federal, 23 Non-Federal, and 5 Canadian. (The winners will be announced during the break.)

Story Time: Journey of the *Oncorhynchus*: A Story of the Pacific Northwest Salmon- Chapter Nine. Each student will need their Journey of the *Oncorhynchus* story book. Before starting the story, set up either the Journey of the *Oncorhynchus* mural by adding **section nine** or the poster. Call attention to the mural/poster by having the students search for the hidden salmon in section nine. The first student to find the hidden salmon will be awarded a prize.

ACTIVITY 9-1: **DANCING RICE**

SCIENCE CONCEPTS/PROCESSES: Cause and Effect, Force, Observe, Define Operationally

OBJECTIVE(s): After completing the activity, students will be able to:

- understand static electricity in terms of positive and negative charges.
- give two examples of static electricity.

MATERIALS:

1 Bag of Puffed Rice	40 large balloons
1 roll of kite string	1 container of ionized salt
40 medium paper plates	1 large container of black pepper
20 pieces of wool cloth	

BACKGROUND INFORMATION:

Why is there a shock when you walk over certain carpets? Why does your comb stick to your hair on a dry winter's day? Why does your socks stick together in the dryer? To understand the answer to these questions, you need to know a little about static electricity.

Static electricity takes it's name from the Latin word *electrum*, which means amber. Amber is a hard yellow rock that is the fossil remains of tree sap. The Greek philosopher Thales (600 BC) discovered that when amber was rubbed with cloth, it attracted bits of straw or hair. Approximately 2,500 years later, with the discovery and understanding of atoms, scientists were able to explain what produced static electricity. It wasn't the yellow rock but electrons that were responsible for static electricity.

All matter is made up of tiny particles called atoms. Atoms are made up of protons, neutrons, and electrons. Protons and neutrons are located in the center of the atom in the nucleus. Electrons make up the outer part of the atom in a fast moving cloud.
Protons have a positive charge, electrons have a negative charge, and neutrons are neutral or have no charge. Generally, an object has an equal numbers of electrons and protons so their charges cancel each other out.

To build an electrical charge, and objects must have electrons removed or added to it. Sometimes when certain objects are rubbed together, friction will rub electrons off one object onto another. The object that has gained electrons has an electric charge that is negative (gained electrons). The object that has lost electrons has an electric charge that is positive (loss electrons). Coulomb's law (pron: koo'lum's) states that charges that are the same repel, opposite charges attract.

Rubbing two objects together sometimes causes static electricity. (It is important to note that all static electricity experiments work best on dry days.) It is static because the electricity doesn't flow (static means standing still). An object that has lost electrons must try and pick some up to be balanced again. The shock you may get from static electricity happens when the object that had most electrons gains them back. The charge jumping from one object to another causes the shock. Sometimes you may even see a spark when this happens. When you rub the balloon on different objects around the room, you find that only certain materials are good at giving up electrons. In general, wool carpets along with your dog or cat etc., give up electrons easily. Cotton and most synthetic materials do not give electrons as easily. Things like rubber and amber actually work to take spare electrons in.

PROCEDURE:

1. In this activity, students will explore static electricity using a wool cloth, a balloon, and puffed rice.
2. Each student should obtain a balloon, a piece of string, a piece of wool cloth, a paper plate, and some puffed rice pieces.
3. After inflating the balloon, tie a piece of string onto the balloon. Students should rub the balloon with the wool cloth. This procedure will add electrons (negative charges) to their balloon. (Electrons may also be added by rubbing the balloon on your hair.)
4. Place the balloon near the pieces of puffed rice. The puffed rice will provide the opposite or positive charge. Since opposite charges are attracted to each other, the puffed rice will stick to the balloon.
5. Students should experiment and see what happens to the puffed rice pieces when they touch the balloon with their finger. What happens?

6. Static electricity can be used to separate different substances. Each group of two students should obtain two paper plates. One plate should contain a mixture of salt and pepper and the other is empty. Challenge the students to separate the pepper from the salt using static electricity. They may accomplish this challenge by holding a charged balloon above the mixture of salt and pepper.
7. Encourage students to experiment with static electricity using their balloons. What happens when two balloons with similar charges approach each other? Will the balloon stick to the wall? Can you make three balloons stick together?

CONCLUSION:

Instructors should bring closure to this activity by asking the following questions:

1. What happens when two different charges approach each other?
2. What happens when two like charges approach each other?
3. Give everyday examples of static electricity.

ACTIVITY 9-2: **MAGNETIC FIELDS**

SCIENCE CONCEPTS/PROCESSES: Cause and Effect, Force, Observe, Define Operationally

OBJECTIVE(s): After completing the activity, students will be able to:

- describe magnetism and the behavior of magnetic poles.
- describe uses for magnets

MATERIALS:	
40 dowels (~20 cm)	120 ring magnets (~2.5 cm dia.)
40 bar magnets	4 boxes of medium paper clips (100 per box)

BACKGROUND INFORMATION:

More than 2000 years ago, ancient Greeks living in a part of Turkey known as Magnesia, discovered a rock which could attract materials containing iron. Because the rock was found in Magnesia, the rock was called magnetite. The Greeks noticed an interesting thing about magnetite. If they allowed it to swing freely from a string, the same part of the rock would always face in the same direction, towards a certain northern star. This star was called the leading star or lodestar, so magnetite also became known as lodestone.

Magnetic forces, like electric forces, involve attraction and repulsion. The magnetic forces usually are strongest at the two ends or poles of a magnet. The simplest kind of magnet is a straight bar of iron. Bar magnets have a north and south pole. If magnets were allowed to swing freely from a string, each pole would point north and south, respectively. The rule for magnetic poles is: **like poles (charges) repel each other and unlike poles attract each another**. The region in which such magnetic forces can act is called a magnetic field.

PROCEDURE:

1. In this activity, students will experiment with magnets.
2. Each group of two students should obtain: 6 ring magnets, 2 dowels, 2 bar magnets, and approximately 20 paper clips.
3. Students should obtain two bar magnets of the same size and hold one in each hand. Holding the magnets with the two north poles facing each other. Slowly bring the magnets together. What do you feel in your hands? Students should record their answers/observations on Student Activity Sheet 9-2.
4. Now move the magnets apart. Hold them with the north pole of one facing the south pole of the other. Slowly bring the magnets together. What do you feel? What happens to the magnets? Record answers on Student Activity Sheet 9-2.
5. Students should explore the possibilities with the ring magnets and the dowels. Challenge the students to arrange magnets in a variety of ways and record their observations on Student Activity Sheet 9-2.

CONCLUSION:

Instructors should bring closure to this activity by asking the following questions:

1. Define magnetism.
2. Describe the properties of magnetic poles?
3. What happens when you bring like poles together? unlike poles?

ACTIVITY 9-3: <u>ELECTRICITY AND YOU</u>

SCIENCE CONCEPTS/PROCESSES: Fundamental Entities, Order, System, Formulate Models

OBJECTIVE(s): After completing the activity, students will be able to:

- describe the path that electricity takes from the hydroelectric dam to their home.

MATERIALS:	
40 Pathway sheets	40 miniature light bulbs
40 miniature sockets	36 m insulated wire (22 gauge)
80 craft sticks	
wire cutters	2 rolls of clear tape
40 house patterns	2.5 lb. of modeling clay
40 notched craft sticks	40 "D" cell batteries
100 medium paper clips	2 rolls of electrical tape
200 twist ties	6 hole punches

BACKGROUND INFORMATION:

The word electricity comes from the Latin word *electrum*, which means amber. The word *electrum* comes from a Greek word that means *shining*. Electricity is the energy associated with electrons that have moved from one place to another. Electric energy is measured by the flow of electrons. The greater the number of electrons, the higher the electric current.

There is tremendous power in moving water. Since ancient times, people have used water power to turn mill wheels. By the late 1800's, most water mills had been replaced by steam engines. With the invention of the electric light bulb in 1879, water power became important once again as a means of generating electricity.

The mechanical energy (energy associated with motion) in falling or flowing water is used to generate usable electricity in a hydroelectric power plant. Hydroelectric means "using water to produce electricity." At a hydroelectric plant, dams hold back millions of tons of water. Some of the water is allowed to pass through pipes and is then channeled past turbines within the plant. The rushing water spins the blades of a turbine in an electric generator to produce electricity. The spinning turbine causes large electromagnets to turn. The spinning electromagnets generates electricity.

☑ For more information see brochure entitled "Hydro Power: How Electricity gets from the River to Your House" at the end of the Day 9 section.

PROCEDURE:

1. In this activity, students will build a transmission tower and circuit connecting the path that electricity travels from the hydroelectric dams to their homes (use the craft sticks connected with twist ties to simulate the transmission towers).
2. Each student will use insulated wire, a pathway pattern, a house pattern, a "D" cell battery, and miniature light bulb/socket to trace the electric pathway.
3. Students will start their electric lines at (1) the Hydroelectric Dam or the "D" cell battery. Students should use insulated wire to connect the dam to the (2) Transmission Tower which will carry electricity further down the line. From the Transmission Tower, electricity is carried to (3) the Substation where electricity is transferred to utility companies. The electricity travels from the substations to (4) their Home.
4. The Pathway sheet includes pictures of (1) a dam, (2) a transmission tower, (3) a substation (X's indicate where wires are to be taped), (4) your home (the "H" indicates where to place your house).
5. To construct the house, students should use the House patterns. A hole punch can be used to add windows to their home. This will allow students to see the light from the bulb.
6. Instructors should read through the brochure "Hydro Power: How Electricity gets from the River to Your House" with their students.

CONCLUSION:

Instructors should bring closure to this activity by asking the following questions:

1. How is the majority of electricity produced in the Northwest?
2. What do transmission towers do?
3. What happens at a substation?
4. How can you conserve electricity at home?
5. How does generating electricity affect salmon?

ACTIVITY 9-4: **ELECTRIFYING FISH FACTS**

SCIENCE CONCEPTS/PROCESSES: Interactions, Energy-Matter, Observe

OBJECTIVE(s): After completing the activity, students will be able to:

- build a circuit.
- review vocabulary introduced throughout the curriculum.

MATERIALS:	
1-200 sq. ft. aluminum foil	40 manila file folders (letter size)
40 green fish facts sheets	40 blue fish facts sheets
40 rolls of clear tape*	40 scissors
40 "D" cell batteries*	24 m insulated wire (22 gauge)
wire strippers*	40 miniature light bulbs*
40 miniature sockets*	masking & electrical tape*
12 single hole punches	40 glue sticks
40 rulers	paper cutter

BACKGROUND INFORMATION:

Electric current can be defined as the flow of an electric charge from one place to another. In order for electric current to be used, energy must be able to move through a special arrangement of conductors called a circuit. All devices that use current, no matter how simple or complex, are constructed with circuits. While circuits are rarely shaped like a circle, they all provide a continuous, unbroken pathway for energy to flow. Most circuits are designed to be either series or parallel. In a series circuit, there is only a single pathway for energy to travel. If for some reason the pathway gets interrupted, the energy stops and the circuit goes dead. Parallel circuits provide for two or more alternative energy pathways. If one section of a parallel circuit gets broken, the rest of the section keeps functioning.

All circuits have at least three basic parts: Something to excite the electrons to get them moving, something to carry the energy, and something to use the energy. In our activity, a "D" cell battery will excite the electrons, aluminum foil strips will carry the energy, and a light bulb will use the energy.

PROCEDURE:

1. In this activity, students will create a quiz board using their knowledge of circuits. When completed, students will use their quiz boards to review facts about the Pacific Salmon.
2. Each student will need a file folder, a blue fish facts sheet, a green fish facts sheet, a "D" cell battery, aluminum foil, scissors, clear tape, insulated wire, and a miniature light bulb/socket.
3. Each student should glue the green fish facts sheet to the larger inside cover of the file folder. The blue fish facts sheet should be cut in pieces along the lines provided.
4. Place the file folder on the table with the fold facing you. On the front cover of the file folder, measure **2.5 centimeters** from the left-hand side of the file and draw a line from the top to the bottom. Students should arrange the numbered terms so that they are glued to the right of the line. Then use a hole punch to make a hole to the left of each term.
5. Measure **2.5 centimeters** from the right-hand side of the front cover and draw a line from the top to the bottom. The definitions of these terms should be arranged on this side of the cover and glued to the left of the line. The definitions should be mixed before arranging on the file folder. Students should use a hole punch to make a hole to the right of each definition.
6. Students should cut aluminum foil strips that are approximately 1 cm in width and a length of approximately 30 cm (teachers may want to do this step ahead of time). One strip is needed for each term. Ten strips are needed for each student.
7. On the back of the front cover, students should connect the correct term with its definition using the strips of aluminum foil. Be sure to cover each hole completely with aluminum foil. The holes should appear as aluminum spots on the front. **Make sure that the aluminum at each hole is not taped over**. Students should use the green fish facts sheet for assistance with vocabulary.
8. When the foil is in place, use electrical or masking tape to **completely** cover the foil strip. It is very important to cover all the aluminum foil with clear tape. If students have exposed foil, the circuit may be broken and the game will not work. The tape is acting as an insulating barrier between each strip of foil.
9. After all the terms are connected with foil, students can use insulated wire, a "D" cell battery, and miniature light bulb/socket to test their knowledge.
10. Students can test each other by switching games. If the answer is correct the light bulb will light up, if not, try again.

CONCLUSION:

Instructors should bring closure to this activity by reviewing the different vocabulary terms and information on the game boards.

Student Activity Sheet 9-2

MAGNETIC FIELDS

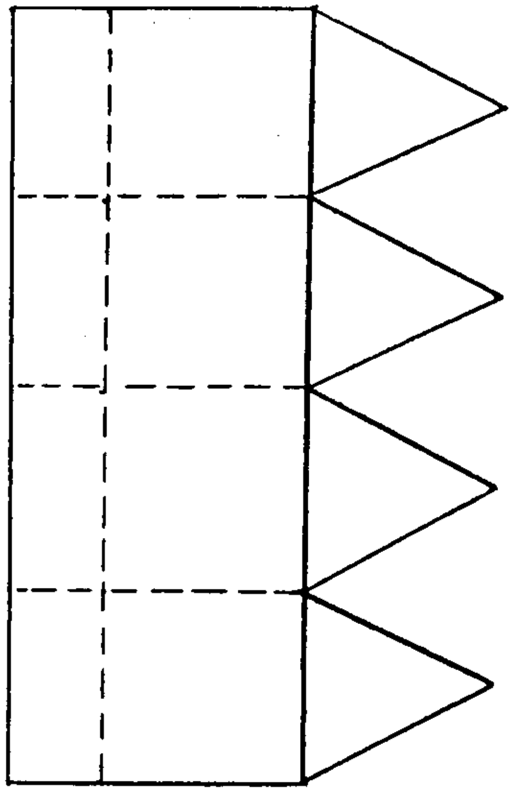
1. Obtain two bar magnets of the same size and hold one in each hand. Holding the magnets with the two north poles facing each other, slowly bring the magnets together.

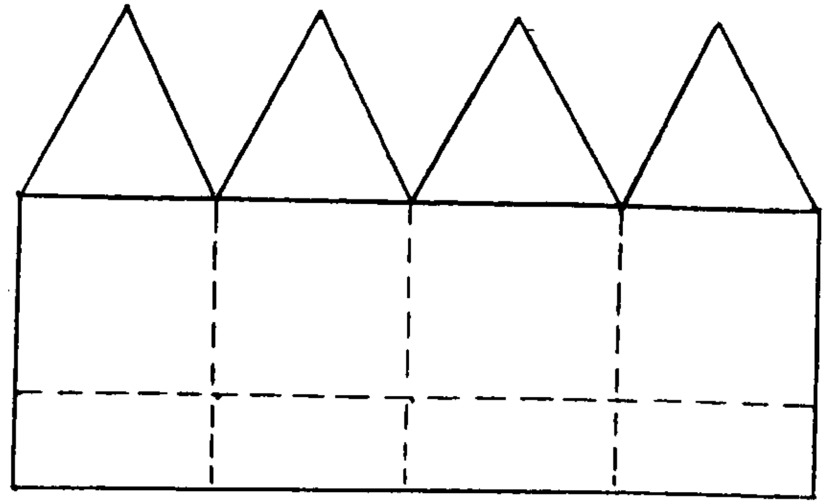
   What do you feel in your hands?

2. Now move the magnets apart. Hold them with the north pole of one facing the south pole of the other. Slowly bring the 2 magnets together.

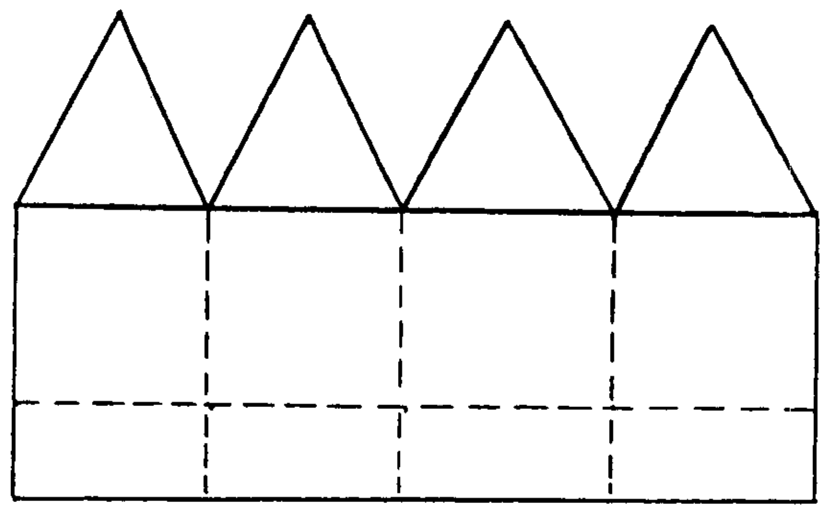
   What do you feel? What happens to the magnets?

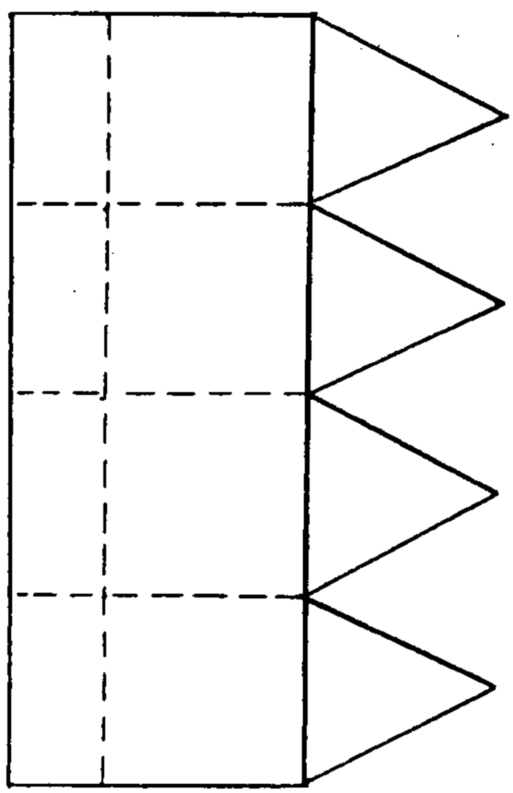
3. Using the ring magnets and dowels, experiment putting on the magnets in different ways. Draw a picture of each different outcome.

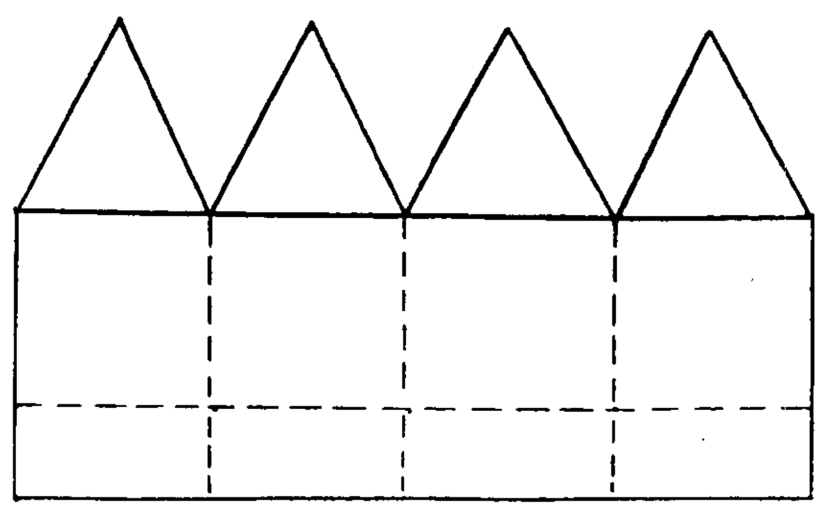




House Patterns

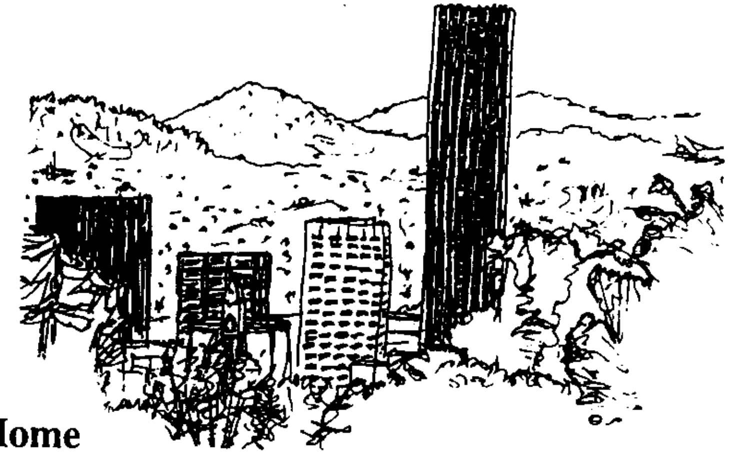






<u>**Pathway Sheet**</u>

#1
Hydroelectric Dam



#4
Your Home

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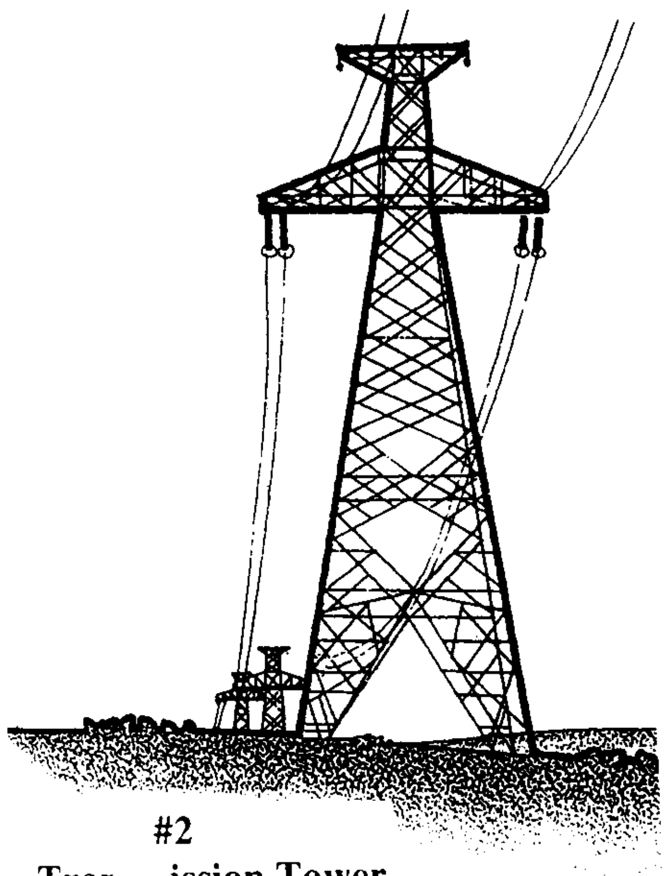
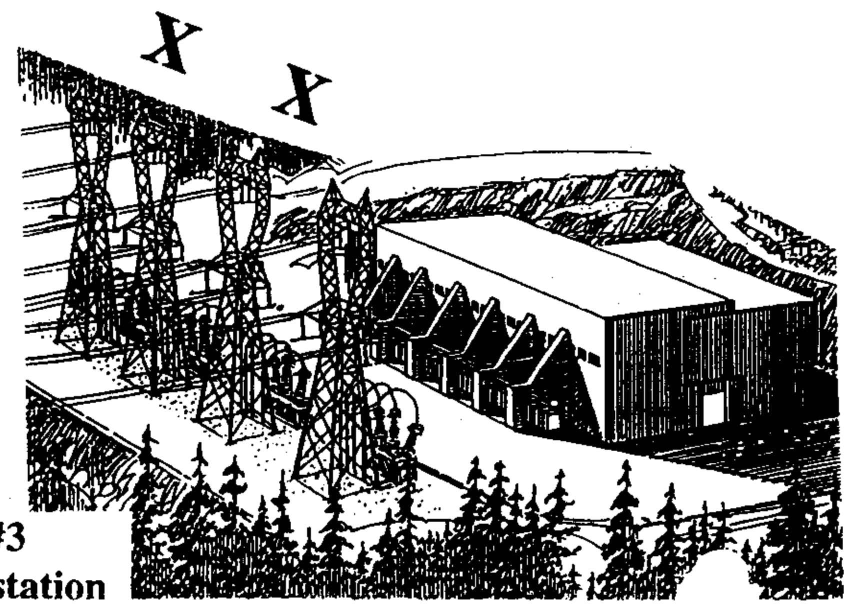


#2
Trar ission Tower

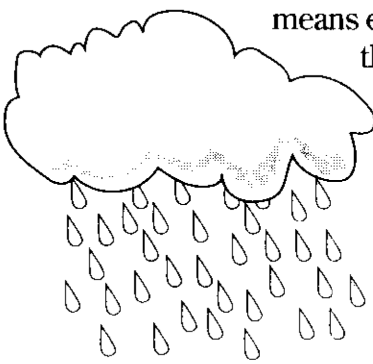


#3
ubstation

Hydro Power:
How Electricity gets from the River to Your House

When you flip on a light switch in your home, electricity makes the light turn on. It makes the wires in the bulb glow bright enough to give off light. But, where does the electricity come from? How does it get to the switch? In the Northwest much of the electricity comes from the rivers that have hydroelectric dams on them.

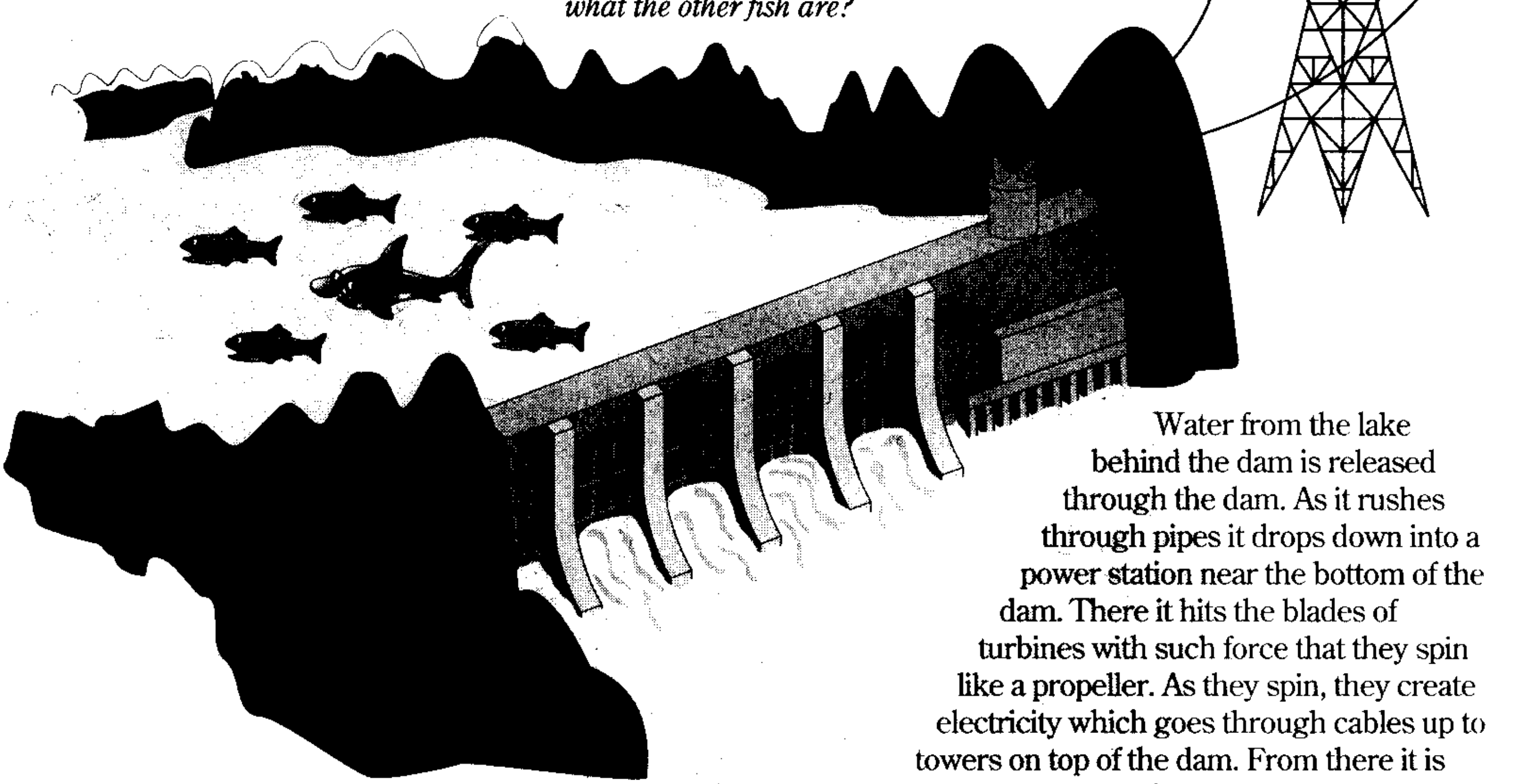
"Hydro" comes from the Greek word for water. Hydroelectric means electricity made by water. Most of the water used to make electricity is from rivers.



Rain fills the rivers. In the spring the winter snows melt and make the rivers swell almost to bursting.

Hydro power comes from dams that are built on rivers. A dam holds back river water so a large reservoir forms. The dam also holds back fish who have to swim up and down the river in order to live, but people help the fish. They give them a free ride on water around the dam. That way they can swim out to sea, return and live a healthy, normal life.

1 *Put an "X" through the fish that doesn't belong in the river. What kind of fish is it? Do you know what the other fish are?*



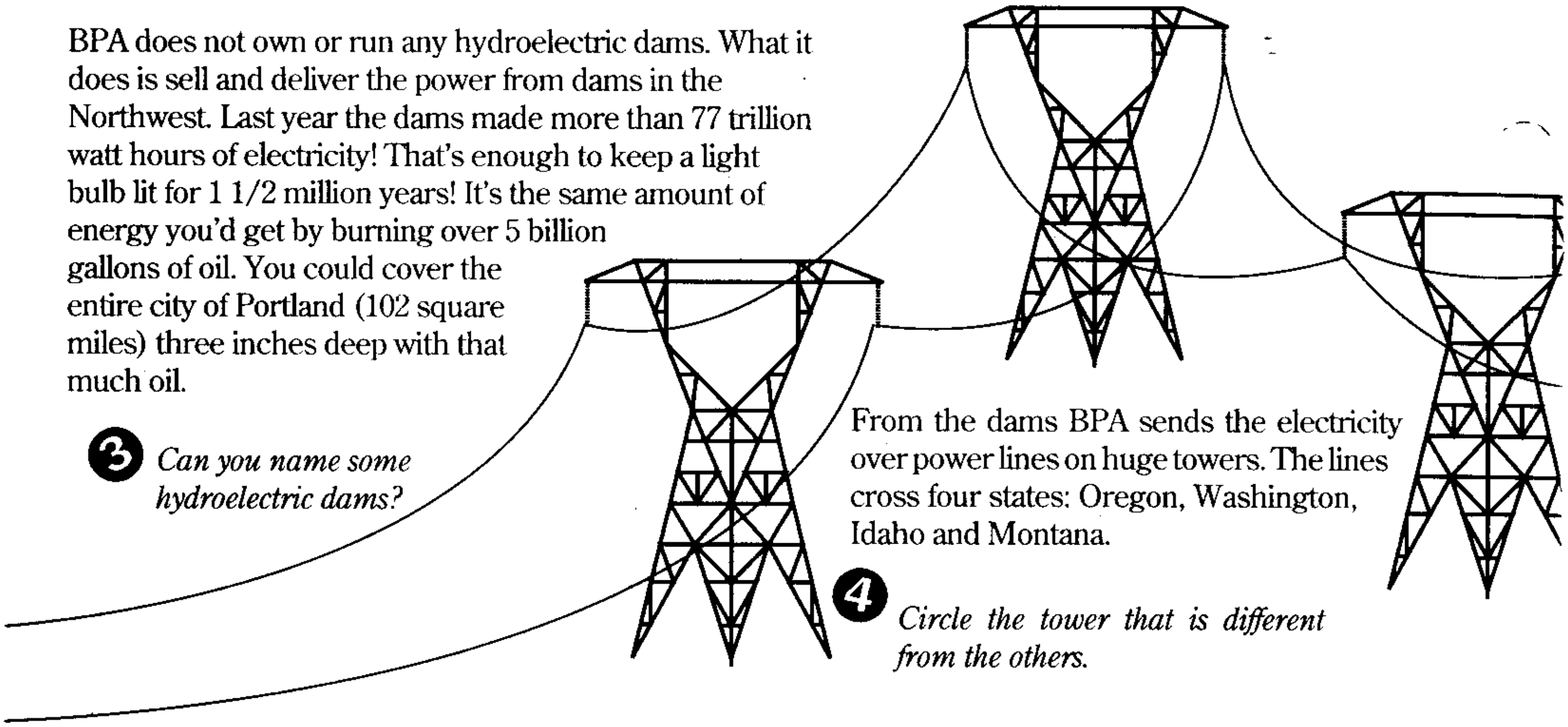
Water from the lake behind the dam is released through the dam. As it rushes through pipes it drops down into a power station near the bottom of the dam. There it hits the blades of turbines with such force that they spin like a propeller. As they spin, they create electricity which goes through cables up to towers on top of the dam. From there it is sent out on power lines for use.

2 *What animal makes a natural dam? Can you draw one?*

BONNEVILLE POWER ADMINISTRATION

From the dam . . .

BPA does not own or run any hydroelectric dams. What it does is sell and deliver the power from dams in the Northwest. Last year the dams made more than 77 trillion watt hours of electricity! That's enough to keep a light bulb lit for 1 1/2 million years! It's the same amount of energy you'd get by burning over 5 billion gallons of oil. You could cover the entire city of Portland (102 square miles) three inches deep with that much oil.

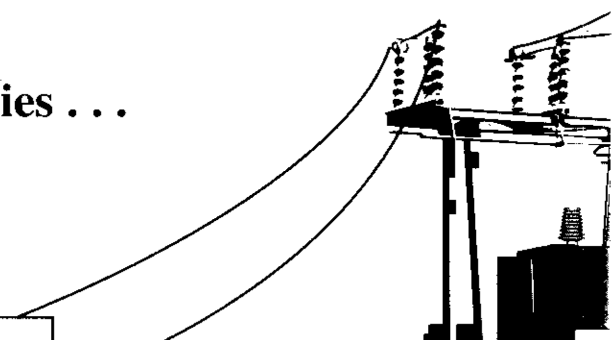


❸ *Can you name some hydroelectric dams?*

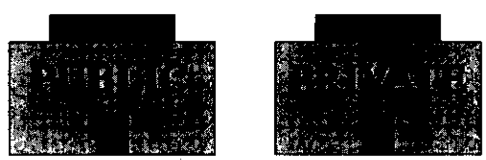
From the dams BPA sends the electricity over power lines on huge towers. The lines cross four states: Oregon, Washington, Idaho and Montana.

❹ *Circle the tower that is different from the others.*

through BPA and utilities . . .

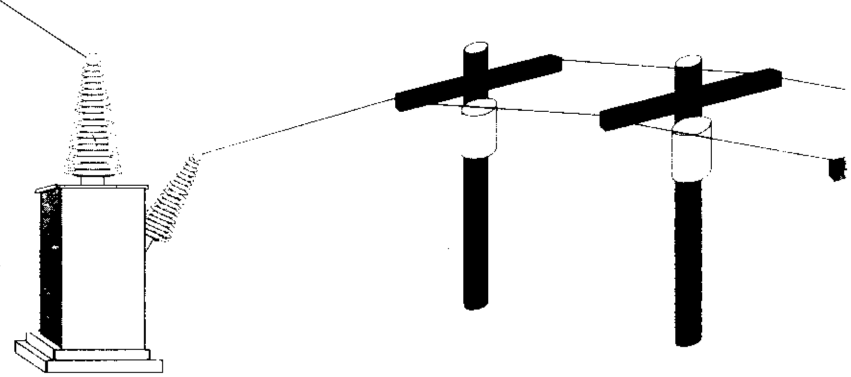


Most of BPA's electricity is sold and sent to utility companies. Then they provide it to their customers. BPA sells to two kinds of utility companies — public and private. The public ones are owned and run by the people they serve. Private utility owners invest their money in the company, but do not run it.



Utility Companies

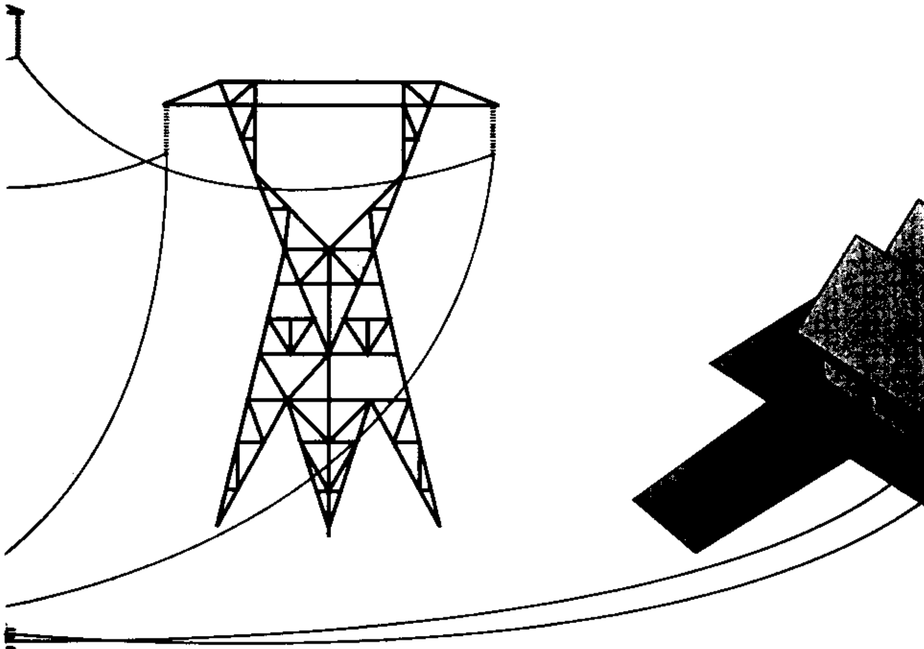
❼ *Can you name your electric utility company?*



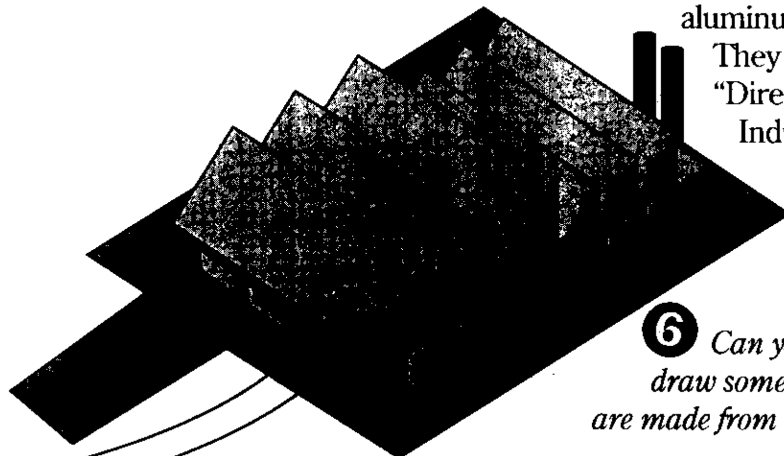
The power coming from the substation is too strong for the wires in homes and other buildings, so it stops at a transformer. The transformer changes it to a lower voltage.

TRANSFORMER

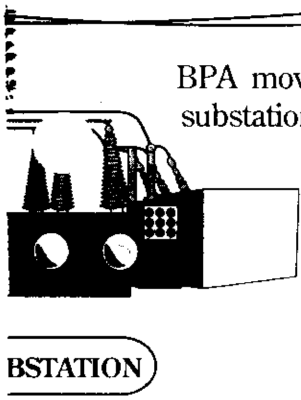
to industry . . .



Some of the electricity goes straight to very large industries, such as aluminum plants. They are called "Direct Service Industries."

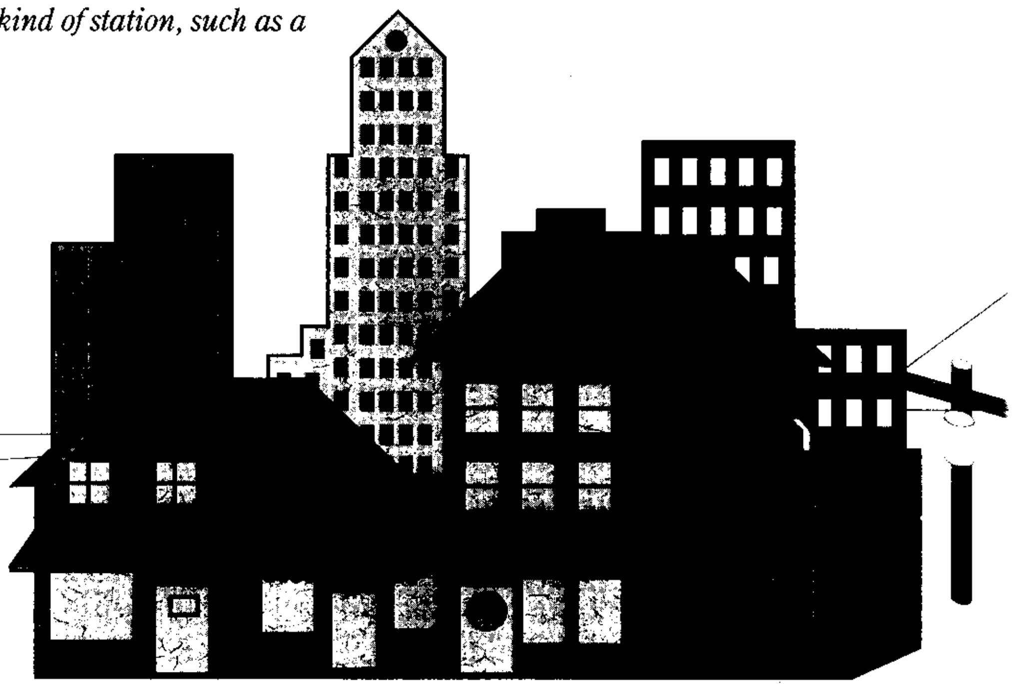


❻ *Can you name and draw some things that are made from aluminum?*

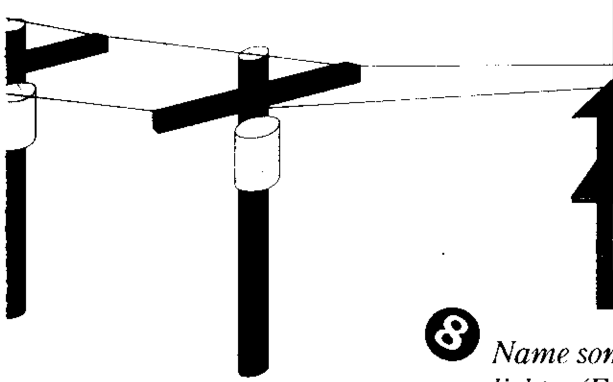


BPA moves the electricity to a power station called a substation. There, utilities and industries take the electricty. They send the power from BPA substations over their own lines to businesses, farms, homes and other customers.

❺ *Name another kind of station, such as a radio station.*



to businesses . . .



❽ *Name some businesses and tell how they would use electricity for something besides lights. (Example: An ice cream shop uses a freezer to keep ice cream from melting.)*

❾ *Where do you see electricity when you are in the city?*

. . . and to your home.

The electricity is sent through large wires or cables. Sometimes the wires are strung on wooden poles. Sometimes they are under the ground. When a wire or cable gets to your house, it is joined to smaller wires. These wires run between the floors, ceilings and walls of your house. They connect to electric outlets and switches.

Like the river it began with, the electricity flows through the lines and turns on whatever you wish with the flip of a switch.

10 *Circle each item that uses electricity in this house. There are 31.*

If you want to learn more about the Northwest's power system call BPA's Public Involvement Office at (503) 230-3478 in Portland, or toll free 1-800-622-4519 nationwide. For additional copies of this brochure call BPA's Document Request Line 1-800-622-4520 (recorded message).

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Activity 5 What is Energy?

Skills: **Observation, Description, Classification, Application, Communication**

Objective(s) Students will be able to describe what energy is, how it can be used, and some different forms that it takes.

Materials: Hydrogen Peroxide, Yeast, C Batteries, 1.5 volt Light Bulbs, Copper Wire, Rope, Plastic Milk Jugs, Tennis Balls, Thermometers, Electrical Tape, Paper Clips, and Meter Sticks

Procedure: Have student groups explore some different types of energy. Examples:

1. Using a battery to light a light bulb (heat, chemical, and radiant energy)

2. Rolling a tennis ball down an inclined plane (two meter sticks) into a second ball (potential and kinetic energy)

3. Making a hydrogen peroxide - yeast reaction to produce heat (chemical energy)

4. Swinging a milk jug filled with water like a pendulum suspended from the ceiling (potential and kinetic energy)

5. Dropping a tennis ball from the edge of a table (potential and kinetic energy)

Conclusion: Begin by defining energy as the capacity to produce change. Next, ask groups to describe how each of the 5 activities showed energy. Accept a lot of latitude on the answers. Ask if the activities showed different kinds of energy and how they were different. Follow the student answers with an explanation of the different kinds of energy represented; namely, heat, light, electrical, potential, and kinetic energy.

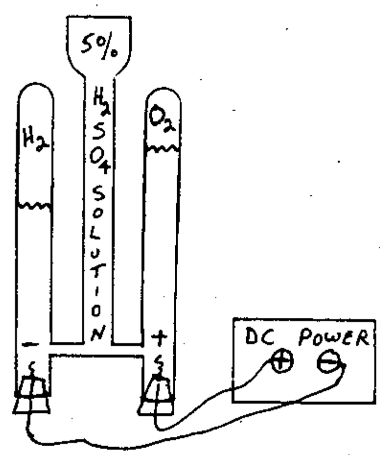
Electrical Energy Demonstration

Demonstrate and explain electric currents and static discharges. Set up electrolysis apparatus to show electricity at work (directions below). While the apparatus separates the hydrogen and oxygen, demonstrate the concept of electricity in other ways. A Tesla Coil and Jacob's Ladder are examples of other ways to demonstrate electric currents.

Procedure:

Begin the activity by telling students that today they are going to see that water can be separated into two different elements: Hydrogen and Oxygen, each having its own characteristics. Demonstrate electrolysis by following the steps 1-4 below.

Step 1. Set up the electrolysis apparatus as shown in the diagram below. Using a funnel, pour a 5% H_2SO_4 (or comparable) solution to completely fill the apparatus. Close the stopcocks or stoppers and connect the DC volt source to the two terminals on the apparatus.



Step 2. Before collecting the gases ask students to notice that one tube is filled halfway with liquid while the other side has no liquid. Collect the gases from the two tubes using a clear plastic sandwich bag after all of the liquid has been bubbled out from one side (hydrogen). Evacuate the air from the bags before filling with gas and use a plastic bag of about the same volume as the collecting tube.

Step 3. Light a wooden splint and place in each bag and have students observe what happens.

Step 4. Explain to students that one bag contains Oxygen which allowed the splint to glow while the other bag contains Hydrogen which explodes on contact with the burning splint.

Activity 6: **Electrolysis** (****adapted from TOPS Learning Systems, 10970 S. Mulino Rd., Canby, OR 97013**)

Skills: Replication, Construction, Handle Materials, Predict, Modeling, Observation

Objective(s) Students will be able to see that water is made up of distinctly different elements which have characteristics unlike that of the compound.

Materials: Test tubes, 1 Quart Water Containers, Insulated Copper Wire, Batteries, Alligator Clips, Paper Clips, Baking Soda, Water, Card Stock. Wire Stripper, Large and Small Marshmallows, Toothpicks

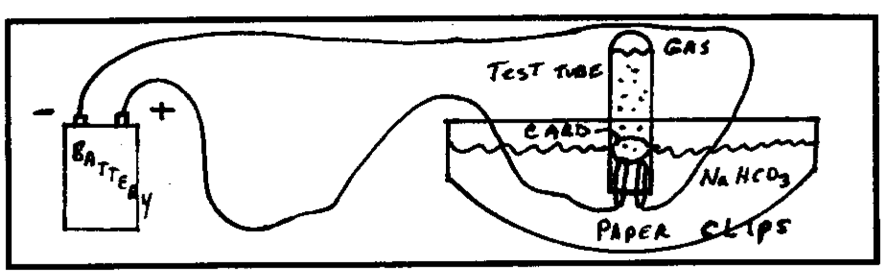
Procedure: **Part A.**

Have students wash hands. Handout large and small bags of marshmallows to students along with toothpicks. Using the large marshmallows to represent oxygen, have them make water molecule models by sticking two toothpicks in a large marshmallow and adding small marshmallows (hydrogen) to the toothpick ends which then represents the H_2O formula for water. Once each student has successfully made a water molecule model, they may eat it.

Part B

Working with a partner, students saturate 500 mL (1 pint) of water with baking soda in a one quart container. Using a test tube for a collector, two electrodes are made from paper clips and attached to a circular card which is inserted into the top of the test tube. Two pieces of insulated wire about 50 cm (18 inches) are connected to the two paper clips. The opposite ends are connected to the positive and negative terminals of a 6-Volt Dry Cell (See Diagram).

Fill the test tube with the baking soda water solution and invert the apparatus in the remaining soda water solution. Bubbles should begin rising in the solution displacing some of the water. When the test tube is nearly filled with gas (Hydrogen), have students pull the electrodes out and cap the tube with their thumb. Light the gas with a match to produce a small explosion as the hydrogen and oxygen from the air recombine to form water.



Diagram

Conclusion: Explain to students how the electricity separates hydrogen and oxygen from the water which collects in the test tube as a gas mixture. The hydrogen (H+ ions) is attracted to the minus (-) electrode from the battery and the oxygen (OH- ions) go to the plus (+) electrode ($4H_2O \rightarrow 4H^+ + 4OH^-$) The hydrogen bubbles off as a gas by receiving electrons ($4\ H^+ + 4e^- \rightarrow 2H_2 \uparrow$) and the OH- combines with 4 electrons to create water and oxygen bubbles ($(4)H^- \rightarrow 2H_2O + O_2 \uparrow + 4e^-$). The baking soda acts as a conductor for the electricity in the water. When the gas mixture is ignited with a match it explodes giving off heat and light energy as the hydrogen combines with oxygen to re-form water.

Ask students to list some ways that water could be used as a fuel and what some advantages might be over more common fuels like oil and gas.

Presentation: **Batteries**

Procedure:

Begin presentation by asking questions like: What kind of things do you use batteries for? What type of energy do we get from batteries? Where does the energy come from? Do batteries last a long time? Is electricity from batteries more expensive than that from your wall plug?

Explain how a battery works using the diagrams provided in the Teacher's Materials section. Show the different kinds of dry cell batteries that are commonly available and how they act to convert chemical energy to electrical energy.

Activity 7 **Making a Wet Cell Battery** **(adapted from PGE, Energy Fundamentals, P 1-17)**

Skills: Construction, Replication, Observe, Handling Materials, Description, Experimenting

Objective(s): Students will be able to construct a simple wet cell battery and observe that electricity is produced through the chemical reaction by measuring it with a voltmeter.

Materials: Aluminum Foil, Paper Towels, 16 Gauge Stranded Insulated Copper Wire, Plastic Cups, Electrical Tape, Wire Strippers, Sodium Hypochlorite (Chlorox Bleach), Voltmeters.

Procedure:

Step 1: Have students line a plastic cup with aluminum foil leaving a piece of foil hanging over the lip of the cup. The aluminum foil is one electrode for the battery.

Step 2: Line the aluminum foil with paper towel which acts as an insulator. Make sure that no part of the towel hangs over the aluminum foil.

Step 3: Take a stripped end of one copper wire and separate the strands to make a ball of wire. Place the ball end in the cup so that the opposite end hangs outside the cup. The paper towel needs to separate the copper wire (the other electrode) from the aluminum foil.

Step 4: Connect the other copper wire to the aluminum foil at one end to the negative (black) terminal as shown as shown in the illustration on the Student Activity Sheet. Connect the wire with the wire ball inside the cup to the positive (red) terminal.

Step 5: Teachers then pour the Chlorox Bleach (Sodium Hypochlorite) to fill the container about half way and cover the exposed portion of the copper wire ball.

Step 6: Students watch the voltmeter to for 4-5 minutes and record the amount of electricity generated. Students may want to repeat the experiment several times.

Step 7 (optional): Connect all of the cups (cells) together in series and measure the voltage to show that each additional cell adds about 1.5 volts to the battery.

Safety: **Caution students not to get the bleach on their hands or clothing. In the event of accidental exposure, wash off immediately with water. Goggles must be worn.**

Conclusion: Consider asking the following questions:

1. What made the electricity?
2. Describe reasons why some of the batteries may not have worked.
3. Why did the amount of electricity vary over a short period of time?
4. What might you do to make you battery last longer
5. Would this be a practical way of providing electricity for your home?

Activity 8 **Making a Light Bulb** (**adapted from PGE, Energy Fundamentals, P 1-17)**)

Skills: Construction, Replication, Handling Materials, Description, Experimenting, Observation

Objective(s): Students will be able to make a simple light bulb and observe that it will light when supplied with electricity

Materials: Tungsten Filament Wire (.1 mm), Clear Jars or Cups, Modeling Clay, 6 Volt Batteries, 20-22 Gauge Solid Copper Wire, Alligator Clips, Wire Strippers, Birthday Candles, Matches

Background:

Incandescent light bulbs have been in use since Thomas Edison first developed a practical version in 1879. You all use Incandescent light bulbs in your homes and automobiles. The process of giving off light when a material is heated is called Incandescence. Incandescent lights all work in the same manner. An electric current is passed through a thin wire with high resistance and high melting point. Due to wire's resistance, it heats up and glows as electricity passes through it. The glass around the filament contains an inert gas that keeps the wire from reacting with the air as it heats up.

In the process of burning an electric light bulb you are converting electrical energy into light energy. Placing your hand on or near a burning light bulb will convince you that that light is energy which we can feel as heat. In this activity you will be making a simple electric light bulb by connecting a battery to wires and a filament inside a jar.

Procedure:

Guide students through the following steps:

Step 1. Take a single strand of tungsten filament wire about 6 centimeters long.

Step 2: Flatten a piece of clay so that it will cover the opening of the jar that you are using for your bulb.

Step 3: Connect an alligator clip to one end of each wire

Step 4: Push each alligator clip through the center area of the clay from below.

Step 5: Connect the filament wire between the two alligator clips.

Step 6: Place a candle in the clay. Light the candle.

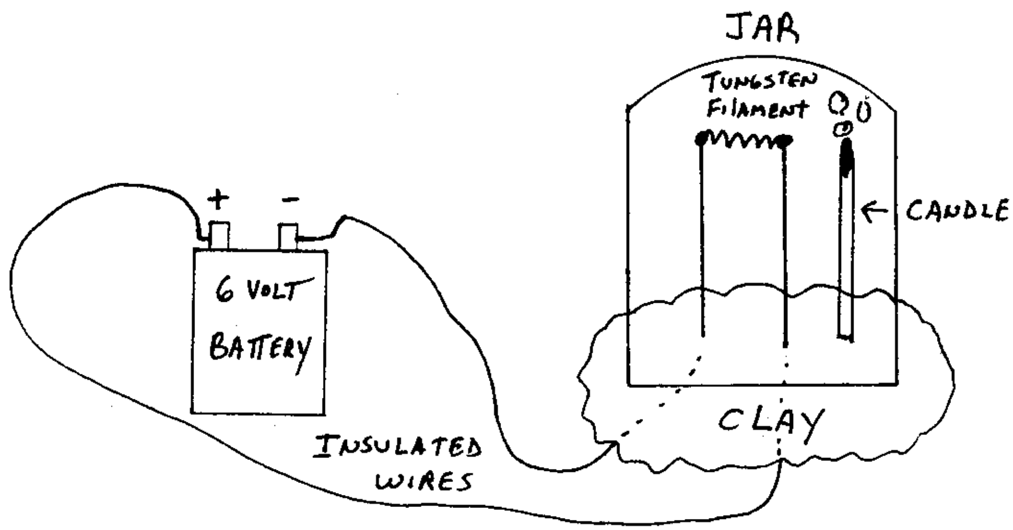
Step 7: Press the jar into the top of the clay and over the filament and candle. Make sure that there are no air leaks.

Step 8: Wait for the candle to burn out.

Step 9: Attach the loose end of each wire to the positive and negative terminals of the 6 volt battery (either wire can go to either battery terminal). *(See Diagram below for example)*

Step 10: Observe the filament glow inside the homemade light bulb.

Optional: Experiment with different lengths of filament to see if you can make a brighter or longer lasting light bulb.



Light Bulb Diagram

Conclusion: Focus on the following types of questions for closure:

1. What caused the light bulb to light if it lighted?
2. Describe some reasons why it may not have worked.
3. Why did the bulbs just burn for a short period of time?
4. What might you do to make longer burning light bulbs?
5. Would this be a practical way of lighting your home?
6. Where does the electricity come from when you use lights at home?

~2:30 p.m. Snack Break

2:50 p.m. Journal Writing Activity (Evaluation)

Students are given journals to use for the science camp and are asked to describe in writing/drawing everything they learned in camp today. Collect journals to review and return to students on Day 2 of camp.

3:00 p.m. Camp Ends for Students

Activity 6 **Electrolysis** **Student Activity Sheet** ____________________
(your name)

Background:

Water is made up of the two elements called hydrogen and oxygen. These two elements are very different from the water they make and you can see this by separating them through the process of electrolysis. In this process electricity is used to break apart the water to form hydrogen gas and a metal oxide. The source of electricity for this activity is a 6 volt battery. The battery has a positive (+) terminal and a negative (-) terminal. The Hydrogen is attracted to the negative terminal and the Oxygen is attracted to the positive terminal.

Vocabulary: **Positive, Negative, Hydrogen, Oxygen, Sodium Bicarbonate, Electrode, Saturated**

Directions: Make your own hydrogen gas by following the steps listed below:

Step 1. Fill a large beaker (500 mL) or container halfway with water and add baking soda slowly until no more will dissolve (saturated). You can tell that the water is saturated by seeing the solid baking soda remaining on the bottom of the container.

Step 2. Fill a shallow bowl half full with the baking soda solution.

Step 3. Take two pieces of insulated copper wire and attach paper clips to one stripped end of each wire.

Step 4. Cut a strip from a 3" x 5" index card that is a little narrower than the paper clip is long.

Step 5. Roll the index card strip into a cylinder that will fit into the test tube you will be using.

Step 6. Attach the two paper clips to opposite sides of the paper cylinder.

Step 7. Put the cylinder, with the clips attached, into the end of the test tube so that just the paper clip ends are below the lip of the test tube.

Step 8. Attach the free ends of each wire to the positive and negative terminals of the battery you are using.

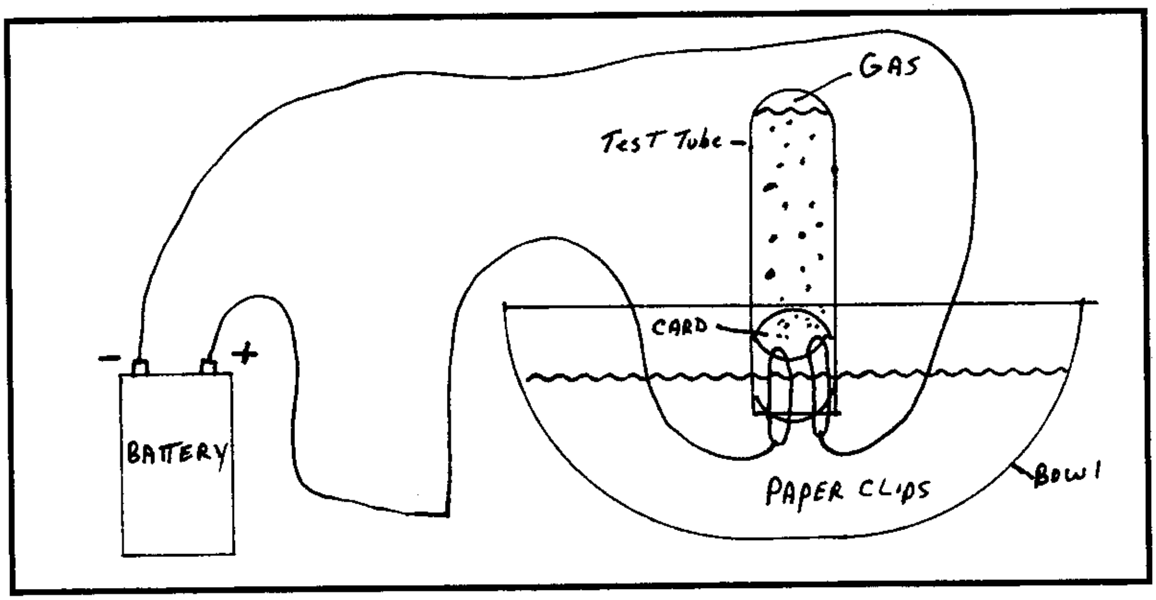
Step 9. Completely fill the test tube with the water solution.

Step 10. Place your thumb on top of the test tube. Quickly turn it upside down and set it below the water level in the bottom of the bowl.

Step 11. Remove your thumb and watch the hydrogen bubbles go up in the test tube.

Step 12. When the gas level reaches the paper clips, hold the wire electrodes and lift the test tube straight up without tilting it.

Step 13. Keeping the test tube vertical to keep the hydrogen inside the test tube, have your instructor place a lighted match at the opening of the test tube. BOOM! See Diagram below:



CONGRATULATIONS! You have made hydrogen.

Activity 7 **Making a Wet Cell Battery** **Student Activity Sheet** ______________
(your name)

Background:

Batteries are used for many things and are an important source of electrical energy for nearly all portable electronic devices. Flashlights, personal stereos, cordless phones, laptop computers, and two-way radios all require batteries. A battery produces electricity by changing stored chemical energy into electrical energy. However, batteries are only temporary sources of electricity and must be recharged or replaced when their chemical reaction ends. Batteries are also an expensive source of electricity, compared to the electricity you get from your wall socket. Can you think of other sources of electricity besides batteries?

Vocabulary: Electrolyte, Electrode, Anode, Cathode

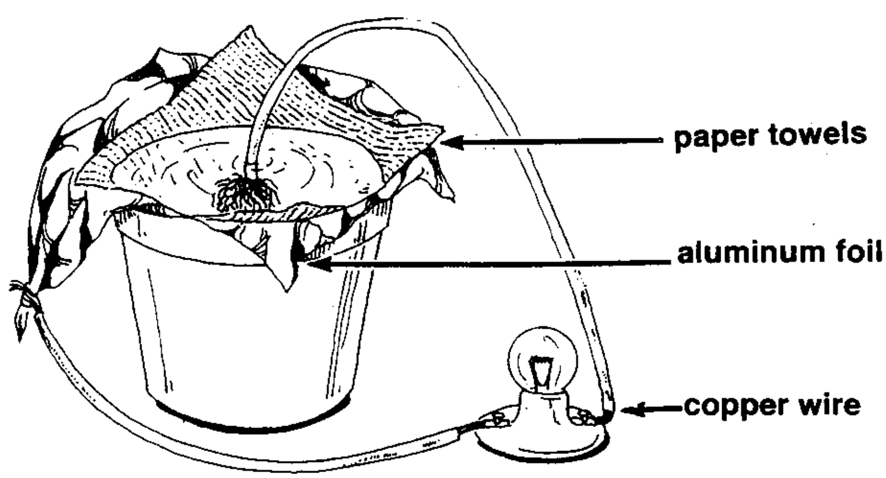
Procedure:

Step 1. Line the inside of the container you were provided with aluminum foil. Make sure that the foil liner hangs over the edge of the container. The aluminum is one electrode of your battery.

Step 2. Line the aluminum foil with paper towel, but do not let any of the paper towel hang over the edge of the container.

Step 3. Take a stranded piece of insulated copper wire that is stripped at both ends and scrunch up one end to make a loose ball of wire. Place the balled end inside the container and the other end outside the container. The paper towel needs to prevent the wire from touching the aluminum foil. The copper wire is the other electrode for your battery.

Step 4. Connect a second copper wire to a piece of the aluminum foil hanging over the edge of the container. The opposite end of this wire is connected to a socket and bulb as shown in the diagram below.



Step 5. Place your container and wires in a secure place and have your instructor pour in the liquid electrolyte so that it covers the copper electrode.

Safety Note

The electrolyte in your battery is household bleach which is a strong chemical and needs to be handled safely.

- **Do not put your fingers in the bleach**
- **Do not move the cup once it has been filled**
- **If bleach gets on your clothing or skin, rinse with cold water immediately**

Step 6. Leave your device connected for 5 minutes and write what your observations of what happens below:

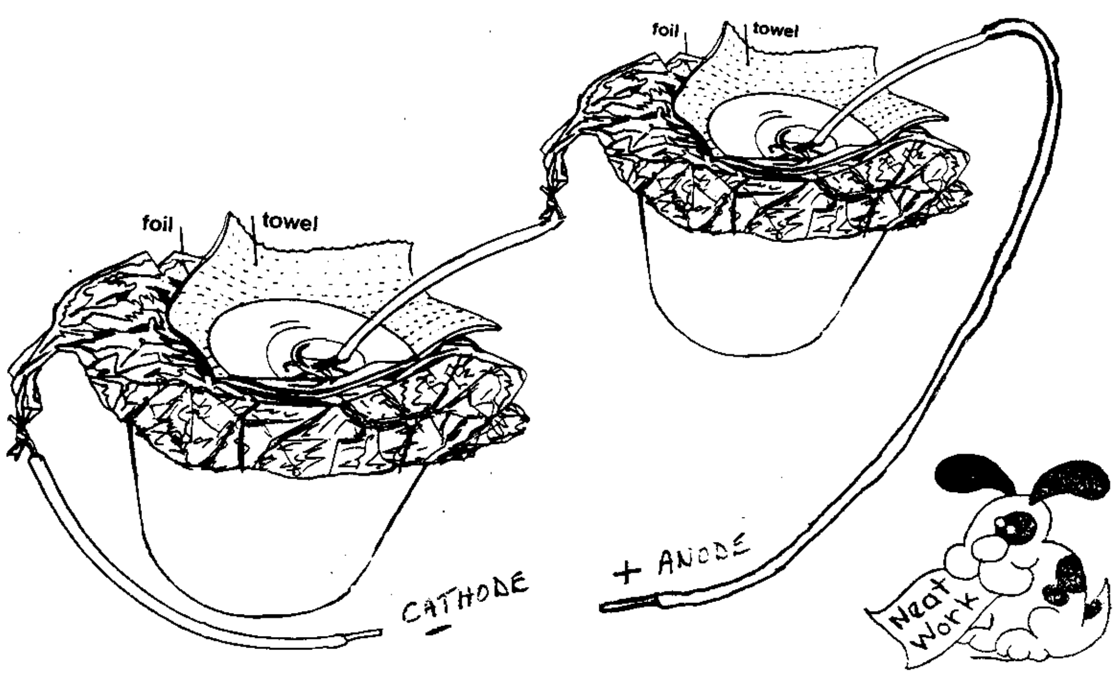
____

____

____

____

Step 7 **(optional)** Connect two or more cells together in series by taking the copper wire from the aluminum foil and connecting it to the balled electrode of a second cell. Connect a light bulb or voltmeter to the opposite electrodes and see what happens. See diagram below.



Activity 8 **Making a Light Bulb** **Student Activity Sheet** _______________
(your name)

Background: Incandescent light bulbs have been in use since Thomas Edison first developed a practical version in 1879. You use Incandescent light bulbs in your homes and automobiles. The process of giving off light when a material is heated is called Incandescence. Incandescent lights all work in the same manner. An electric current is passed through a thin wire with high resistance and high melting point. Due to wire's resistance, it heats up and glows as electricity passes through it. The glass around the filament contains an inert gas that keeps the wire from reacting with the air as it heats up.

In the process of burning an electric light bulb you are converting electrical energy into light energy. Placing your hand on or near a burning light bulb will convince you that that light is energy which we can feel as heat. In this activity you will be making a simple electric light bulb by connecting a battery to wires and a filament inside a jar.

Vocabulary: Resistance, Incandescence, Filament, Inert, Tungsten

Directions:

Step 1. Take a single strand of tungsten filament wire about 6 centimeters long.

Step 2: Flatten a piece of clay so that it will cover the opening of the jar that you are using for your bulb.

Step 3: Connect an alligator clip to one end of each wire

Step 4: Push each alligator clip through the center area of the clay from below.

Step 5: Connect the filament wire between the two alligator clips.

Step 6: Place a candle in the clay. Light the candle.

Step 7: Press the jar into the top of the clay and over the filament and candle. Make sure that there are no air leaks.

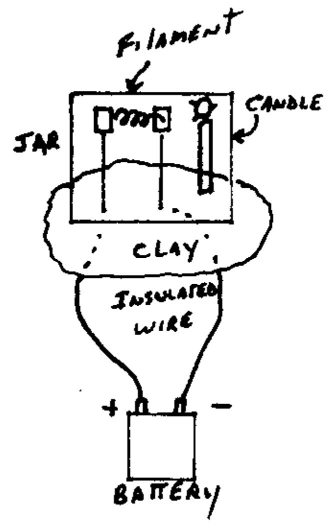
Step 8: Wait for the candle to burn out.

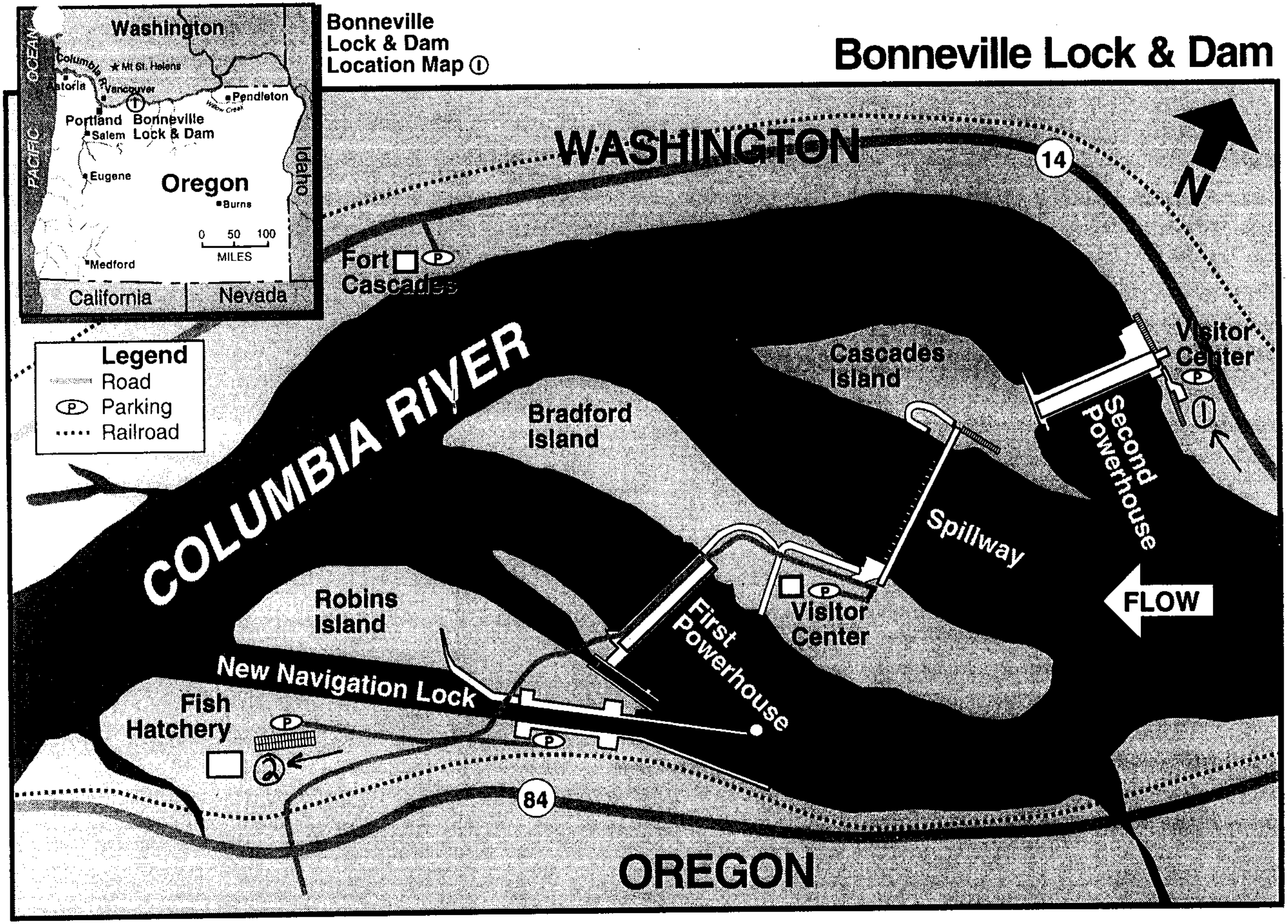
Step 9: Attach the loose end of each wire to the positive and negative terminals of the 6 volt battery (either wire can go to either battery terminal).

Step 10: Observe the filament glow inside the homemade light bulb.

(See Diagram below for example)

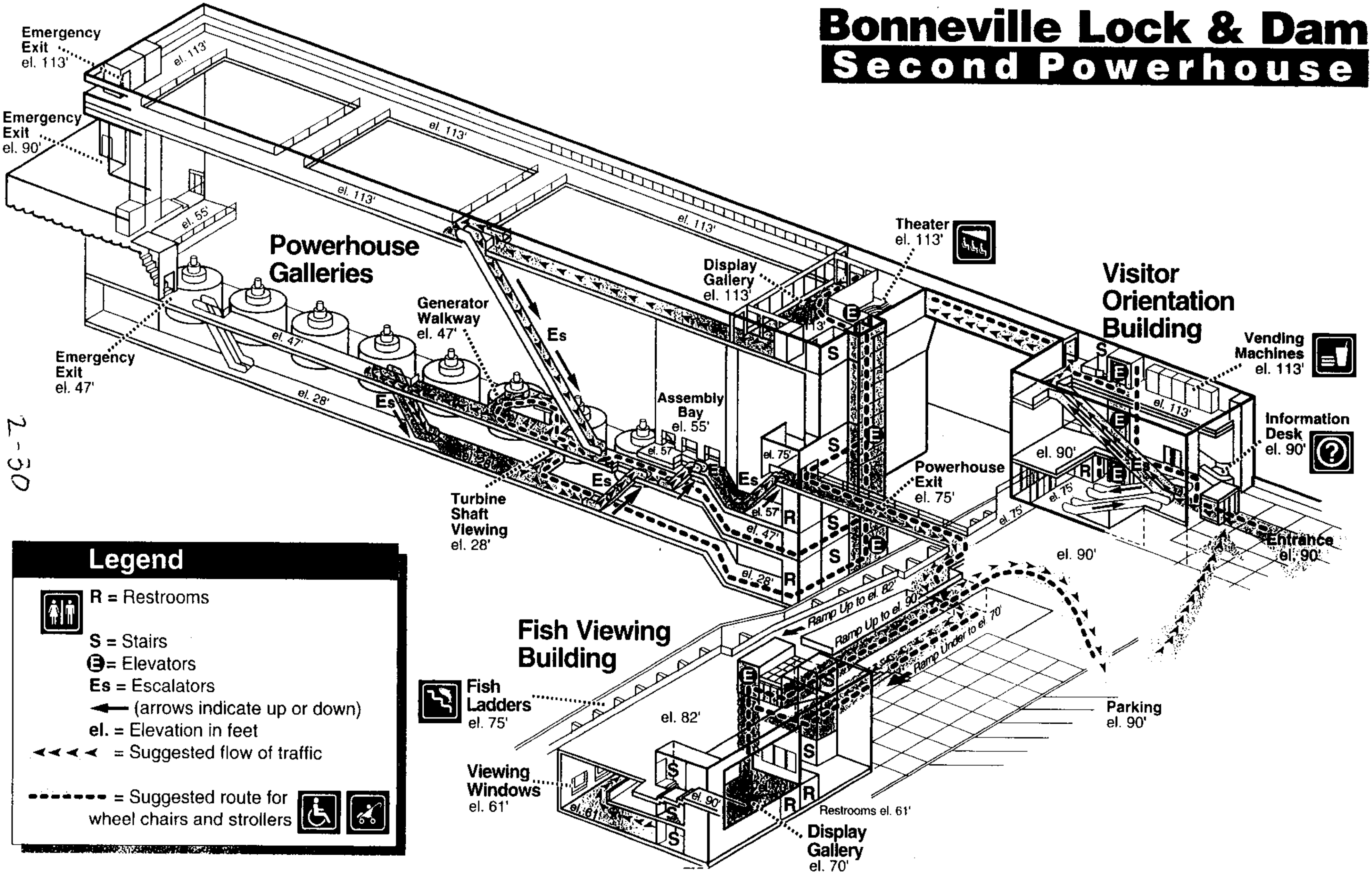
Optional: Experiment with different lengths of filament to see if you can make a brighter or longer lasting light bulb.





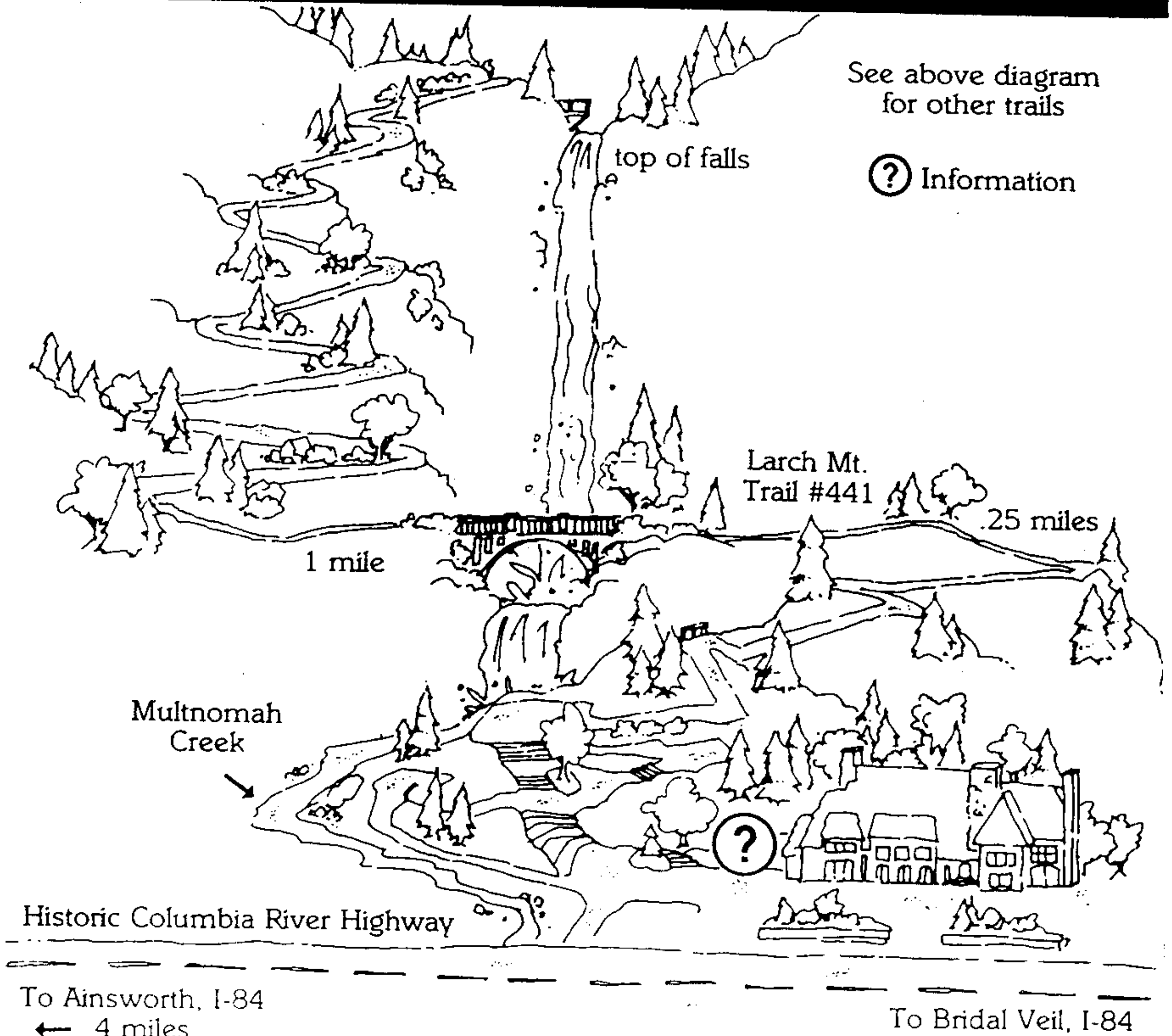
Bonneville Lock & Dam
Bonneville
Lock & Dam
Location Map ①
Washington
Oregon
Idaho
California
Nevada
PACIFIC OCEAN
Columbia R.
Mt St. Helens
Astoria
Vancouver
Pendleton
Portland
Bonneville
Lock & Dam
Salem
Eugene
Burns
Medford
0 50 100
MILES
Legend
Road
Parking
Railroad
WASHINGTON
14
N
Fort
Cascades
COLUMBIA RIVER
Cascades
Island
Visitor
Center
Bradford
Island
Second
Powerhouse
Spillway
FLOW
Robins
Island
First
Powerhouse
Visitor
Center
New Navigation Lock
Fish
Hatchery
84
OREGON
2-29

Bonneville Lock & Dam
Second Powerhouse



2-30

Multnomah Falls



How to get there

Day 6 # Teacher's Guide

9:00 a.m. **Serve Breakfast to Campers in Groups**

9:15 a.m. Dam Guestimation Activity

Have students estimate the number of 100 watt light bulbs that Bonneville generators could light at maximum capacity (answer: 10 million 100W bulbs). Present winning student(s) with suitable prize.

9:20 a.m. Students write in their journals about what they learned from the Bonneville Dam field trip.

Activity 23 **Power Board Game** (adapted from Northwest Power System Curriculum)

Skills: Working in groups, Analysis, Computation, Application, Evaluation, Generalization, Reporting, Synthesis

Objective(s): Students will be able to show the effects of alternative energy sources on future demand for electricity and consider choices that will be good for the environment.

Materials: Game Boards, Resource Cards, Pass Cards, $Utility Money, Marking Pens, Guidelines, Worksheets, Recording Sheets, Dice, Game Pieces (Hershey Kisses)

Background: *The Power Board Game has been designed to be a hands-on activity for use by students in grades 4 - 8. High school students and adults may also find the game fun and educational with potential for generating more in-depth discussions about conservation, energy, environmental impacts, and economic considerations. The major objectives for the game are:*

- ☺ *Provide an understanding of the region's electrical energy needs.*
- ☺ *Allow participants to simulate a business decision-making process.*
- ☺ *Present environmental issues which can impact energy resource choices.*
- ☺ *Describe energy resource alternatives which could provide our future energy.*
- ☺ *Generate discussion of energy issues which will likely affect energy production.*

In order to play the game, participants will need a Power Game Board, sufficient play money to provide $1.2 billion in script for each team playing, dice, game pieces (Hershey's Kisses work well), Recording Sheet, and five "Pass Cards" per team. These items (except for game pieces and dice) are available free of charge by calling BPA's Public Information Office at 230-3478 in Portland; or toll free 1-800-622-4519.

The game is intended to be played by groups of 2-4 players who form a company and then make consensus decisions, after discussing the choices and issues, as they travel around the game board. The Power Board Game is designed to reflect certain real world realities: Sometimes success or failure is a matter of good or bad fortune, but choices can be made which can and do effect the outcome. It is also designed to raise environmental and economic awareness in relation to making choices for our energy future. The concept of being socially responsible, while *not directly articulated, is plainly evident as participants play the game. The game should precipitate a lively classroom discussion with any age group*

Mature players may want to consider operating costs, changes in technology, transmission distances, climatic change, population characteristics, regional geography, political consequences, inflation, or other issues to include as variations to the basic game.

Procedure: Students should have a basic understanding of how electricity is produced at hydroelectric dams and that there are other ways to generate electricity. Discuss with students the range of ways to produce and conserve electricity and why the region will require more energy in the future. Explain to students that their group is going to represent a power company who will have to plan to increase the output of electricity by 3,000 megawatts over the next 10 years. Following discussion, hand out the Student Activity sheets and materials which show the financial costs and environmental impacts for each of the different types of production. Have students go through the steps below to play the simulation (steps are also listed on the game board).

Step 1. Each team gets a stack of Power Resource Cards, the Power Game board, 1.2 $billion Utility $Money, Recording Sheet, game piece (**Hershey's Kisses or other wrapped candy work well**), five Pass Cards, and two dice.
Step 2. Option A: Form two companies that will play against one another (**companies should consist of 2-4 team members**).
Option B: Form one company that will play to stay in business.
Step 3. Write your company name and design a company logo to put on the game board.
Step 4. Each company needs to purchase 3,000 megawatts of additional electricity to meet the power needs for the next 10 years.
Step 5. Each company member takes turns rolling the dice. Read the Power Resource Card for the space landed on.
Step 6. Your company must decide whether or not to purchase the resource based on the listed cost, the megawatts, and environmental impact (Hydro Power is the one resource which can not be purchased because no additional power from this source is likely).
Step 7. If your company chooses not to purchase, a pass chip is given to the bank. If your company chooses to purchase, pay the listed cost. Once all pass chips are used, you must purchase the resource.
Step 8. Continue playing up to six rounds (trips around the board) or until your company has purchased 3,000 megawatts of power.
Step 9. As you play, record resources purchased, money spent, megawatts, and rounds completed on the recording sheet.
Step 10. The company that manages to purchase the 3,000 megawatts of power, and has the most $Money at the end, wins. If you run out of $Money, you go out of business.

Conclusion: To bring this activity to closure, ask students to respond to questions such as these:

1. If your company went out of business, what would you do differently?
2. Besides cost and environmental impacts, what else would a company need to consider (in reality) for purchasing future energy?
3. Which type of resource alternatives cost the most and the least?
4. What would you do with any money that was left after buying the electrical resources?
5. In the event that demand for electricity was greater than 3,000 megawatts, what would you do?
6. If your company produced more electricity than people wanted to buy, what would you do with the surplus?

Snack Break

Activity 24 **Insulation Station (PGE)**

Skills: Construction, Measurement, Observation, Comparison, Evaluation, Graphing

Objective(s): Students will be able to observe the effects of insulation on keeping a house warm in the winter and cool in the summer.

Materials: Thermometers, Ice, Hot Water, PGE Insulation Station Kits, Stopwatches, Activity Sheets, Scissors, Tape

Procedure: Provide kits to each of the students in their work groups. One student will construct a house with no insulation. A second student constructs a house with wall insulation. A third student constructs a house with wall and ceiling insulation. A fourth student constructs a house with wall, ceiling, and floor insulation. If more than 4 students are grouped together, include the student(s) to do the timing for the others. Have groups perform the following steps:

Step 1. Heat water until it reaches 150 degrees F. (65 degrees C.) using a thermometer to test temperature. Have students fill the film canister provided with hot water and place it immediately inside the houses constructed. Record the temperature inside the house every 30 seconds until it stops warming and record the results on your worksheet.

Step 2. Have students repeat step one above using the same canister filled with ice or ice water this time and again have them record temperatures on their worksheets every 30 seconds until the temperature stops dropping.

Step 3. Provide graph paper with the X and Y axis pre-labeled with time and temperature readings. Have students plot the data from their worksheets on the graph paper.

Step 4. Have students compare their individual results with the others in their group.

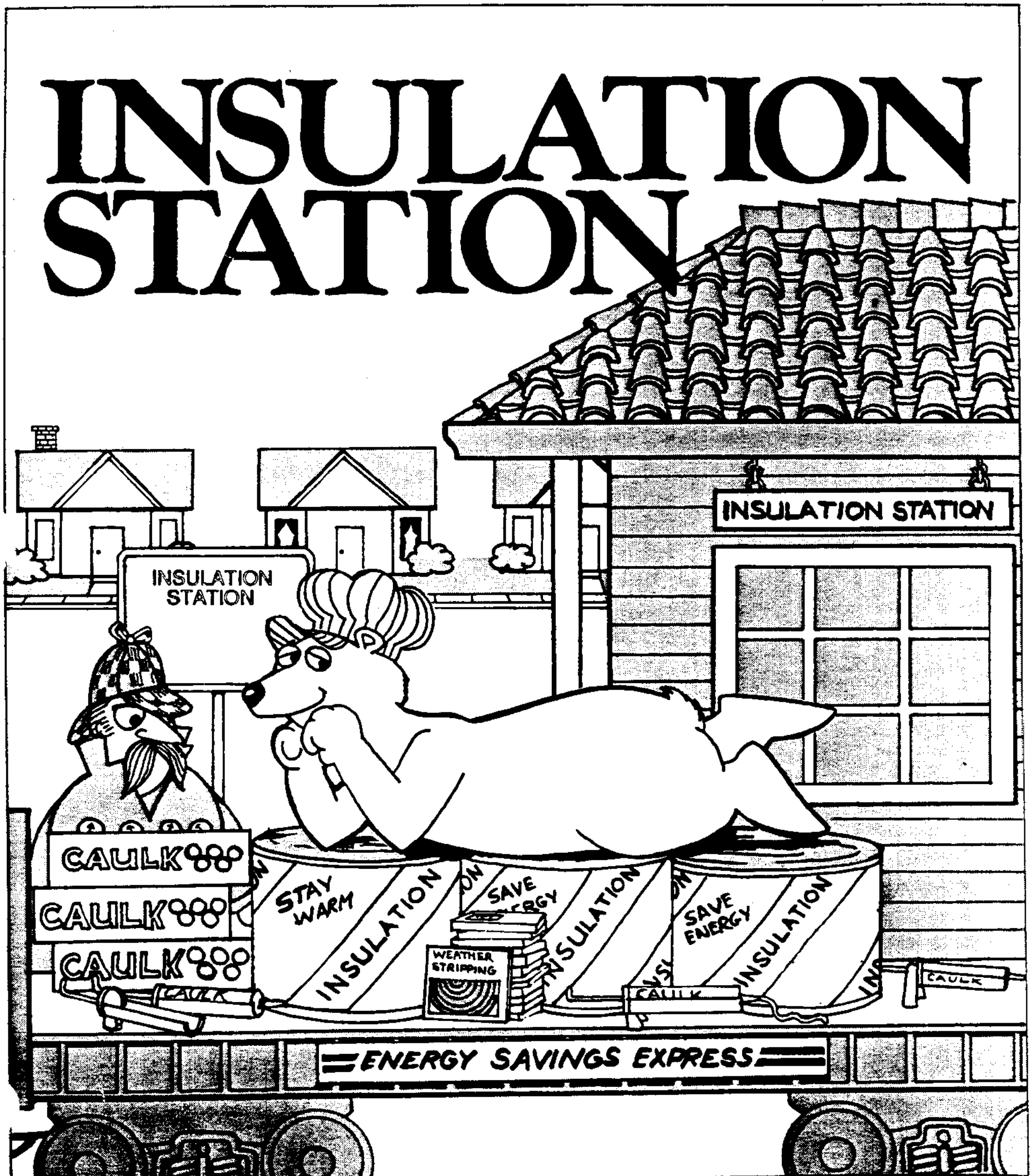
Conclusion: Bring closure to this activity by focusing on questions similar to those below:

1. Which house would use the least amount of energy to keep it warm in winter and cool in summer?
2. Which house warmed up or cooled off the fastest?
3. Which house stayed warm or cool the longest?
4. Which house would probably cost the least to heat and cool?
5. Why is it a good idea to insulate houses?
6. How does insulating a house conserve energy?

INSULATION STATION

Activity 24

STUDENT COPY



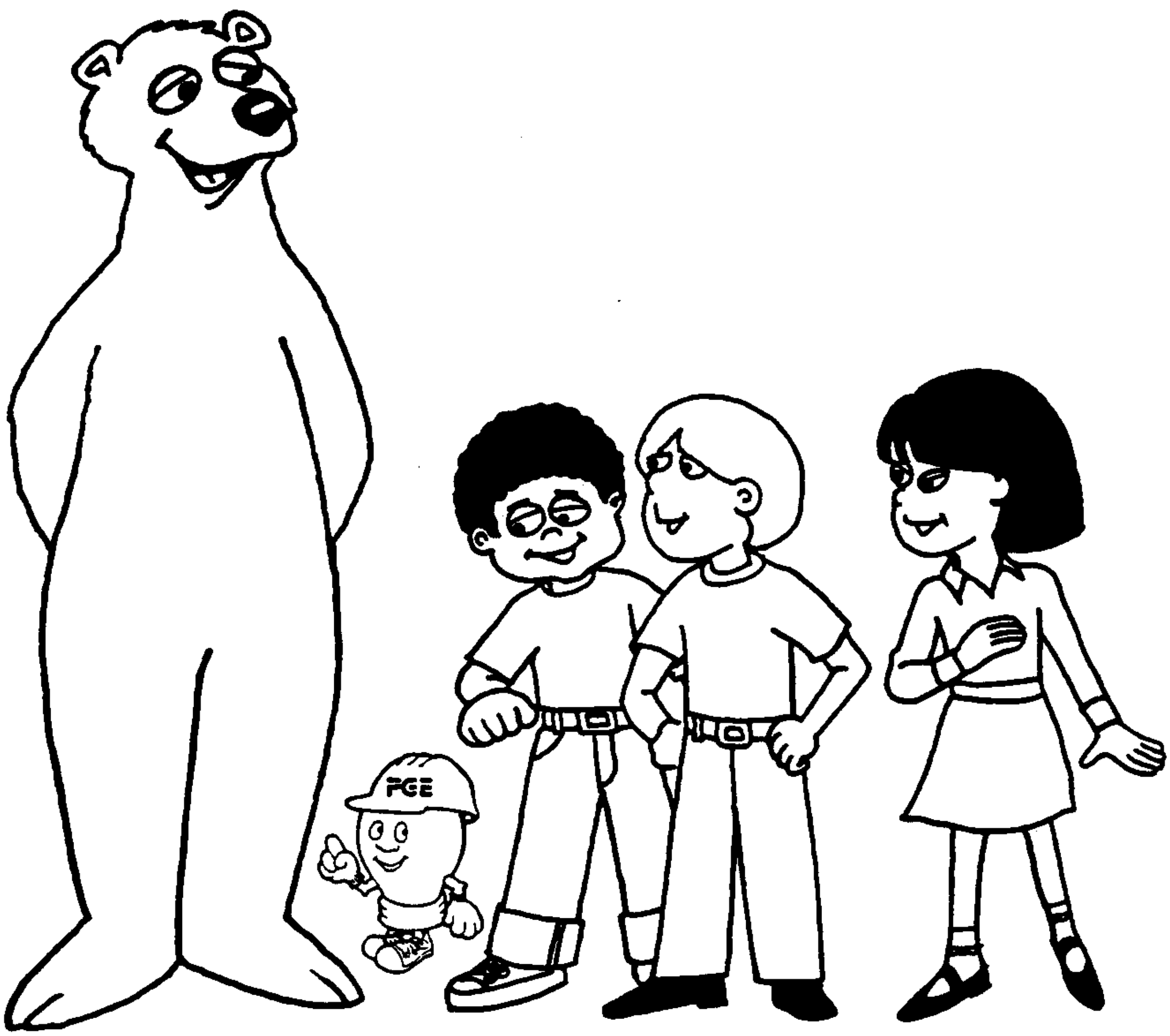
Dear Students,

Welcome to Insulation Station! Everyday we use a lot of energy at school and at home. Most of it is used for heating air and water, getting light, and running machines that do things for us.

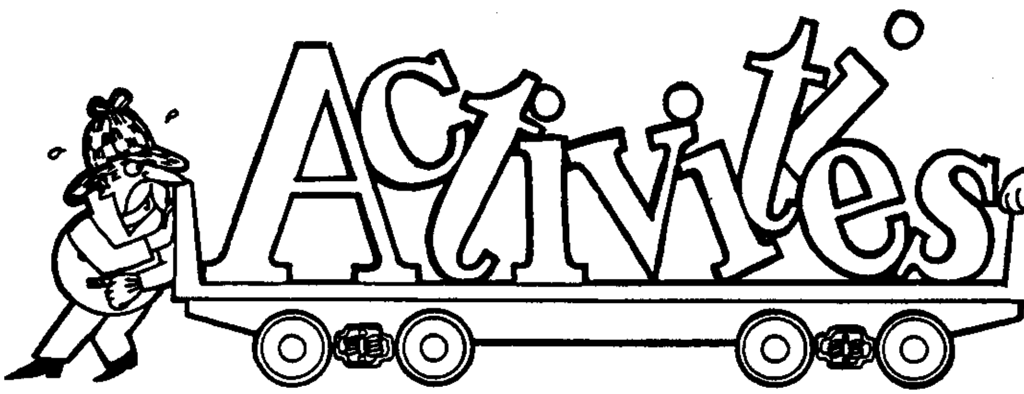
In Insulation Station you will learn that it is important to use this energy wisely and efficiently. You will learn about energy-efficient homes. In fact, you will have a chance to experiment with insulating a model energy-efficient home.

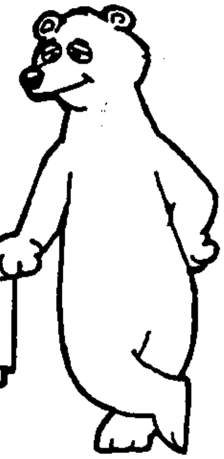
Remember to share what you learn with your parents, especially the home energy audit activity.

P.S. Have fun!

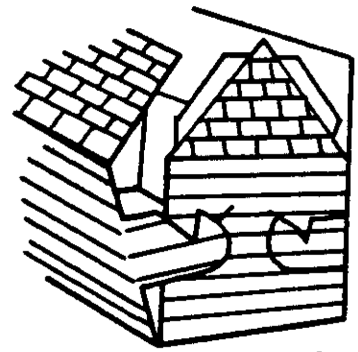


Insulation Station Model Home

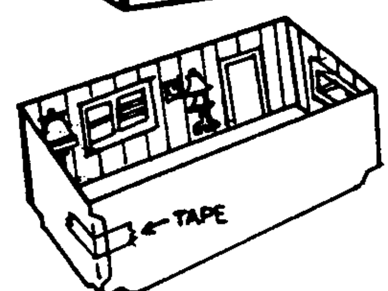




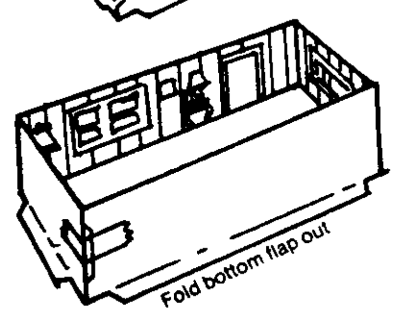
Directions: How To Build Your Insulation Station Model Home



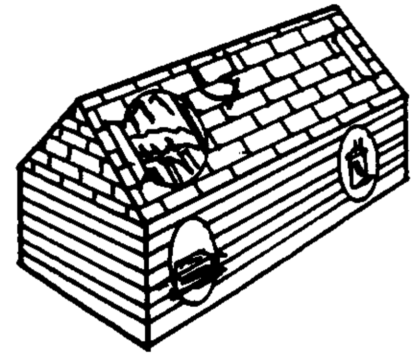
1. Begin connecting the outside walls together by placing the hooked tabs into the pre-cut slots. Continue in all the remaining tabs until you have all sides connected.



2. Now take the inside wall and bend on each fold, then tape it together.

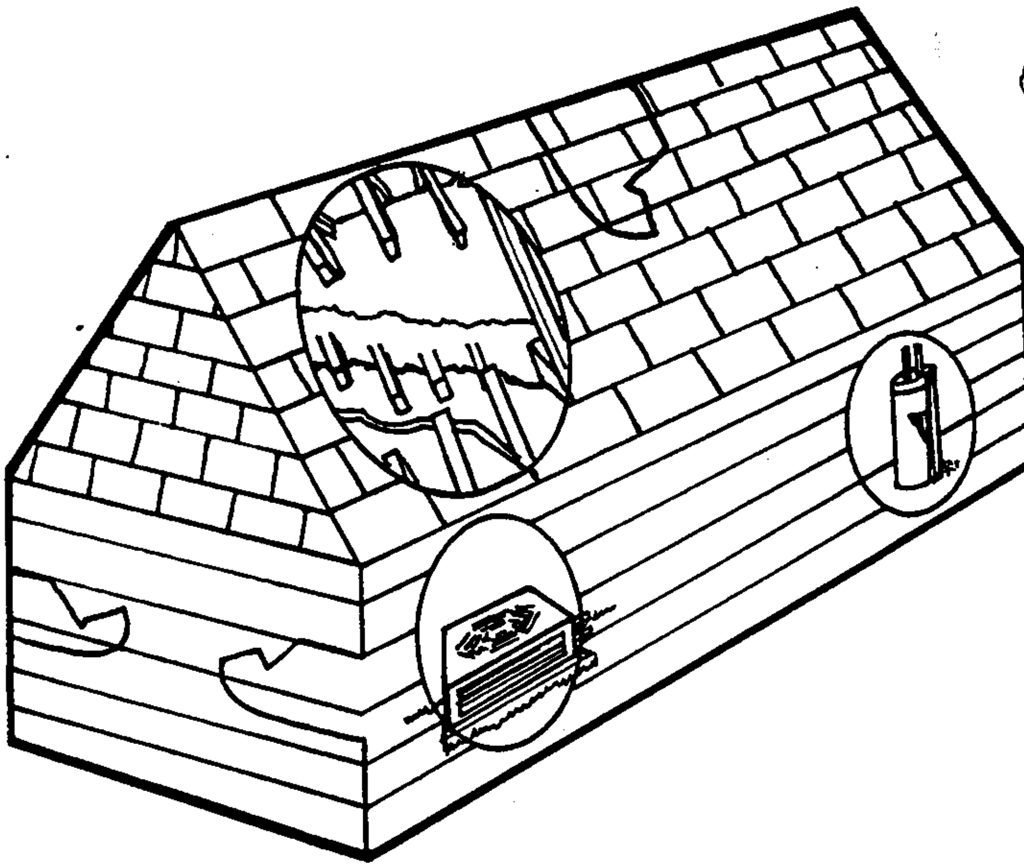


3. Next fold the bottom flaps of the inside wall outward. (Towards you!) This is now ready to go inside your model house!

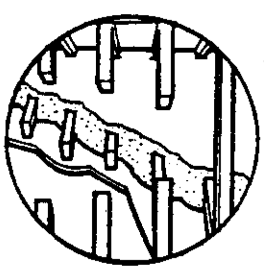


4. Finish by folding the roof and putting the tabs in the slot. Now you are ready for a scientific investigation. Have Fun!

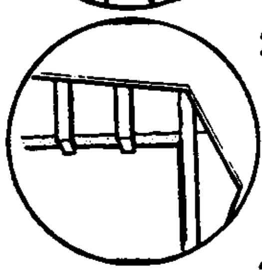
Energy Features That Make Sense



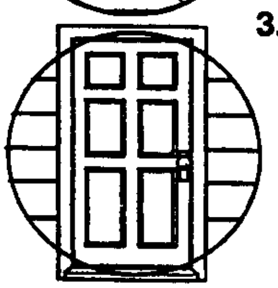
Find each of the six conservation features listed below on your model house. Write the number of each featutre in the matching red circle on your model house.



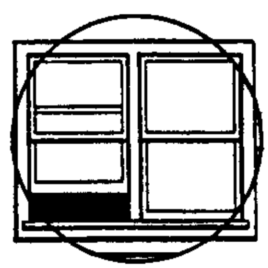
1. Ceiling Insulation
Insulation above the ceiling (in the attic) of a home.



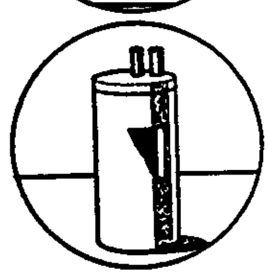
2. Floor Insulation
Insulation under the entire floor of a house.



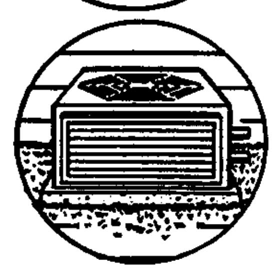
3. Insulated Door
Insulated doors, with weather-stripping all around, stop air leaks and heat loss.



4. Thermal Windows
Windows with double panes of glass stop heat loss. Caulking around window frames stop air leaks.



5. Water Heater Insulation
Well insulated water heaters save energy.



6. Efficient Heat System
An efficient heating system in a properly insulated home saves energy and money. A heat pump is very efficient. It provides both heating and cooling.

Insulation Experiment

Heat
Keeping it in
Keeping it out

PURPOSE

This experiment will help you find out how wall, ceiling, and floor insulation affect heat loss from a home.

MATERIALS AND EQUIPMENT

Your group will need:

1. Four completely assembled Insulation Station model homes.
2. Five thermometers.
3. Cotton for insulation.
4. White tray for ceiling insulation.
5. Gray tray for floor insulation.
6. Four small plastic bottles with caps.
7. Tape.
8. Hot water (60° C).
9. Refrigerator or freezer for ice.

PROCEDURES

I. Find the Hole for the Thermometer.

Look at your assembled model home.

Find the rocking chair on one of the end walls.

The thermometer will be going through the opening cut in the back of the chair, **and through the corresponding opening in the outside wall.**

Push the thermometer through the hole in the outer wall, then through the hole in the inside wall. **(The bulb of the thermometer should be inside the house.)**

Do this for all four model homes your group will be using.

II. Insulating the Houses

You will be preparing four different houses for use in this experiment. Each home will be insulated differently. Then, you can compare how well each different home design holds heat inside. In another part of the experiment, you will also investigate how well each home is able to stay cool — keep heat outside. Below are descriptions of how each of the four homes should be insulated.

House #1

This house will **not** be insulated. It will be used in the experiment just as it is now.

House #2

This house will have its walls insulated. To insulate the walls, carefully push insulation into the space between the inside and outside walls of the house. Use the point of your pencil to push the insulation into place. Be sure you completely fill the space between the walls. Be careful not to leave gaps of uninsulated space. Also, be sure to push the insulation up against the thermometer, so there are no uninsulated gaps. **Be careful not to compress it as this will reduce its insulation value.**

House #3

The walls of House #3 should be insulated just as was done for House #2. In addition, the ceiling will be insulated.

The first step in insulating the ceiling is to find the cardboard tray which fits inside the top of your model home. Place insulation on top of the tray about 1/2" deep. Be sure to cover the tray thoroughly. Do not leave any gaps or open spaces. Open the roof and put the tray in place inside your model home.

House #4

The walls and ceiling of House #4 should be insulated just as was done for Houses #2 and #3. In addition, the floor will be insulated.

The first step in insulating the floor is to find the gray cardboard tray which represents the foundation for the home. Place insulation on top of the tray about 1/2" deep. Be sure to cover the tray thoroughly. Do not leave any gaps or open spaces.

Now, place your model home on top of the insulation. This will act as insulation for the floor of the model home.

III. Keeping the Heat In.

1. The first step is to determine the starting temperature inside the house. This is the normal air temperature. So, you just need to read the temperature of the thermometer right now, before you do anything else.
2. Record this starting temperature on the data chart — "Keeping The Heat In" — for each home next to "O" in the time column.
3. Fill a plastic bottle with hot water.
4. Place a thermometer in the bottle.
5. Watch the thermometer carefully. When the temperature drops to 60°C, remove the thermometer from the bottle. Put the cap on. Quickly place the bottle in House #1. Begin timing the experiment as soon as the bottle goes in the house. (Be sure the bottle is directly in the middle of the gray circle in the center of the floor of the house.)
6. Close the roof of the house as fast as you can.
7. Every minute (from the time you first put the bottle in the house) you should check the temperature of your house and record it on the data chart.
8. Have one person from your group continue to watch the temperature of House #1 and record the results on the data chart.
9. Now the rest of the group should repeat this procedure for Houses #2, #3, and #4. Start one house at a time. Remember, put the bottle of water in the house when the water temperature reaches exactly 60°C. Once each house is set up and someone is recording temperatures, then go on to the next one.
10. Continue recording temperatures for each house until you have filled all of the spaces on the data chart.

IV. Staying Cool— Keeping The Heat Out

1. Repeat the steps given in Section III, "Keeping The Heat In", except use a plastic bottle containing ice in place of the hot water.
2. Monitor and record the temperatures for each of the four houses on the data chart — "Staying Cool".

V. Plotting Your Results

1. On the following page you will find a graph for plotting your results.
2. You will be plotting two sets of lines for each house, one for heating and one for cooling.
3. All eight lines will go on this one graph.
4. So that you will be able to tell which line goes with each house, use a different color line for each house. Use a solid line for the "heating" results and a dashed line for the "cooling" results.
5. Select a color to use for House #1's two lines. Color the box next to "House #1" in the upper-right corner of the chart with this color. Then draw the two lines for House #1 using this same color.
6. Repeat this procedure for Houses #2, #3 and #4.

DATA CHART

STAYING COOL—KEEPING THE HEAT OUT

TIME	HOME #1	HOME #2	HOME #3	HOME #4
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

DATA CHART

STAYING WARM—KEEPING THE HEAT IN

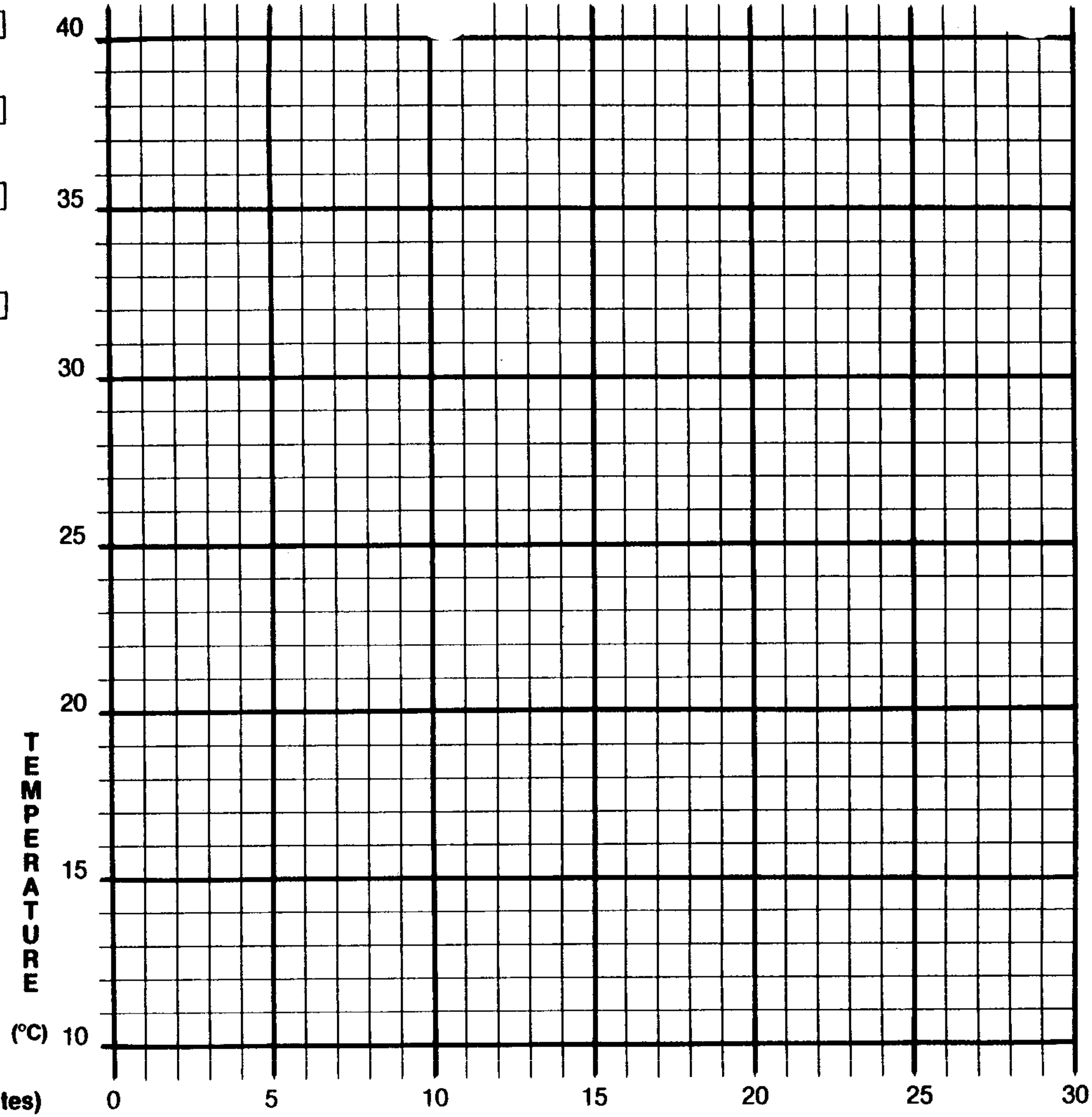
TIME	HOME #1	HOME #2	HOME #3	HOME #4
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Hou.
(uninsulated)

House #2
(walls insulated)

House #3
(walls and ceilings insulated)

House #4
(walls, ceilings and floors insulated)



QUESTIONS About Your Insulation Experiment

Name ____________________

1. a. When heating the model homes with hot water, in which home did the highest temperature occur? The lowest temperature?

   b. When cooling the model homes with ice, in which home did the highest temperature occur? The lowest temperature?

2. How do you explain these results?

3. Which house holds heat inside the best?

4. Which house has the least ability to hold heat inside?

5. If you were really heating these homes, which would use the greatest amount of energy?

6. Which would use the smallest amount of energy for heating?

7. Why would this be important to a home owner?

8. Based on what you know about insulation, and the results of this experiment, which house would stay the coolest on a warm, sunny day? Why?

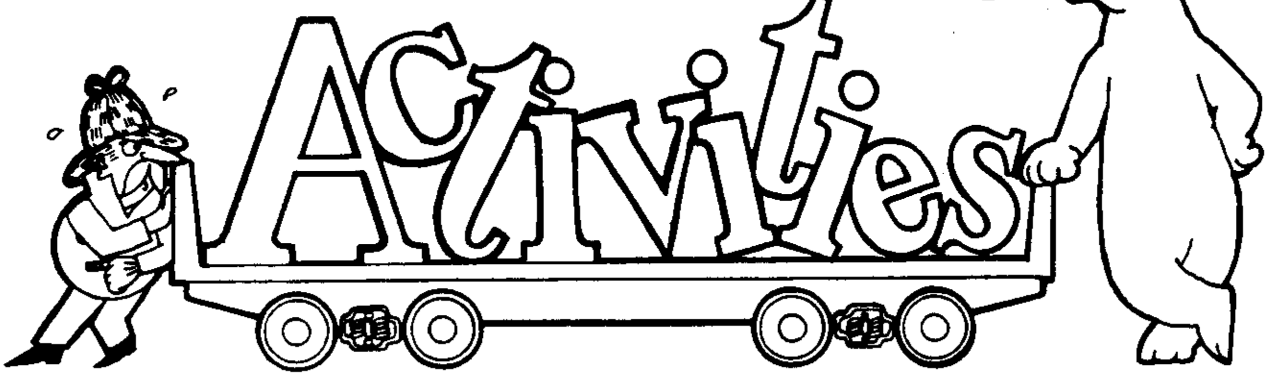
9. Which house would use the greatest amount of energy for air conditioning?

10. Which house would use the least amount of energy for air conditioning?

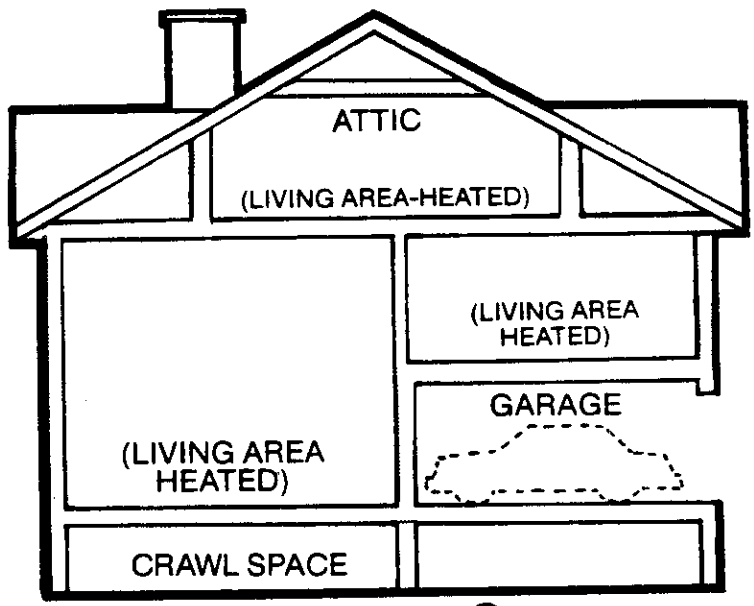
11. Why is this important to the home owner?

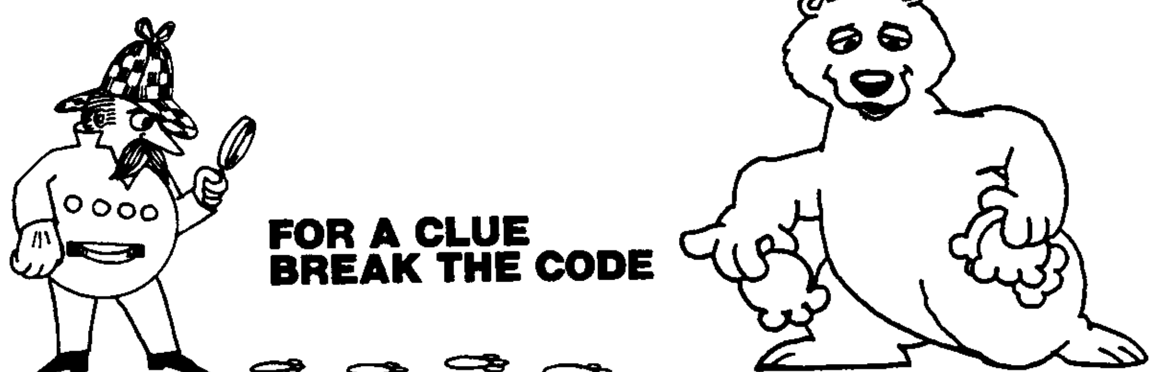
12. Insulation reduces the flow of heat: (Circle the correct answer)
    a. Into a house from the outside environment.
    b. Out of a house from the inside living space.
    c. Both "a" and "b".

Insulation — The Warm Wrap



Directions: Shade in all areas where insulation is needed to keep the house warm.





FOR A CLUE BREAK THE CODE

CODE CHART

1	16	9	21	6	20	11	2	8	15	5	19	12	24	3	10	18	14	25	4	23	17	7	26	22	13
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

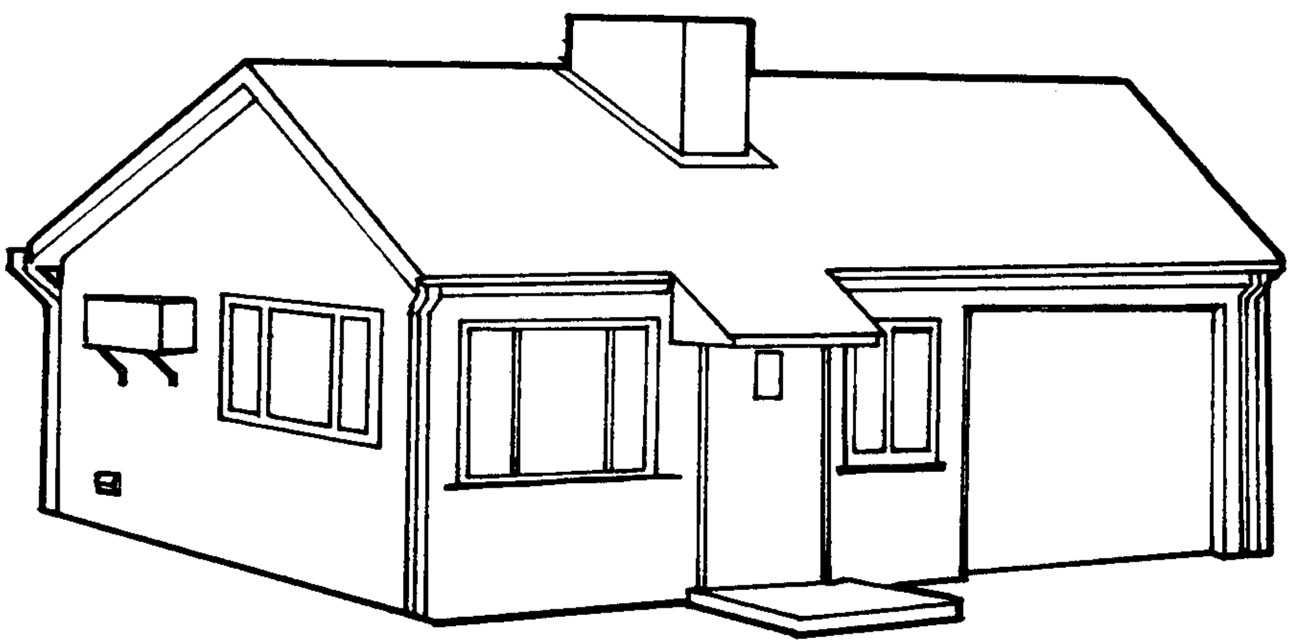
2 3 12 6 / 8 24 25 23 19 1 4 8 3 24 / 8 25 / 1 / 9 3 24 4 8 24 23 3 23 25

16 1 14 14 8 6 14 / 7 2 8 9 2 / 25 23 14 14 3 23 24 21 25 / 4 2 6 / 19 8 17 8 24 11

25 10 1 9 6 / 3 20 / 1 / 2 3 23 25 6 / 4 3 / 25 4 3 10 / 2 6 1 4 / 20 19 3 7

CAULKING AND WEATHER STRIPPING
WHERE ARE YOU?

DIRECTIONS
Complete this page by adding a "C" where caulking is needed and a "W" where weather stripping is called for.
CLUE: Caulking and weather stripping stop air leaks.



Why is it a good idea to have adequate caulking and weatherstripping?

____

____

____

CEILINGS, WALLS, CRAWL SPACES

The attic or ceiling of my house is insulated:	___ YES	___ NO
The outside walls of my house are insulated: (Have someone help you with this.)	___ YES	___ NO
The floor of my house is insulated (For those that don't have a basement.)	___ YES	___ NO

HEATING

My home is heated by: ______________________

The heating ducts are insulated.	___ YES	___ NO
Our water heater is insulated.	___ YES	___ NO
The hot water pipes are insulated.	___ YES	___ NO

OTHER THINGS TO CHECK

My house has caulking to fill the holes where wire and pipes go through the floors and walls.	___ YES	___ NO
There is caulking where the house joins the foundation.	___ YES	___ NO
My house has a plastic or other vapor barrier around all outside walls.	___ YES	___ NO

2-54

USE ENERGY WISELY...
IT MAKES SENSE

Auditor: ______________________

Date of Audit: ______________________ 19 ____

DOORS

My house has ________ doors opening to the outside.
NUMBER

These doors are:

Wood ___ Glass Single ___ Insulated Double Paned ___ Metal ___

Our doors are weather stripped.* ___ YES ___ NO

*WEATHER STRIPPING is narrow strips of material placed over and in movable joints of windows and doors.

The condition of the weather stripping is:

good ________ in need of repair ________

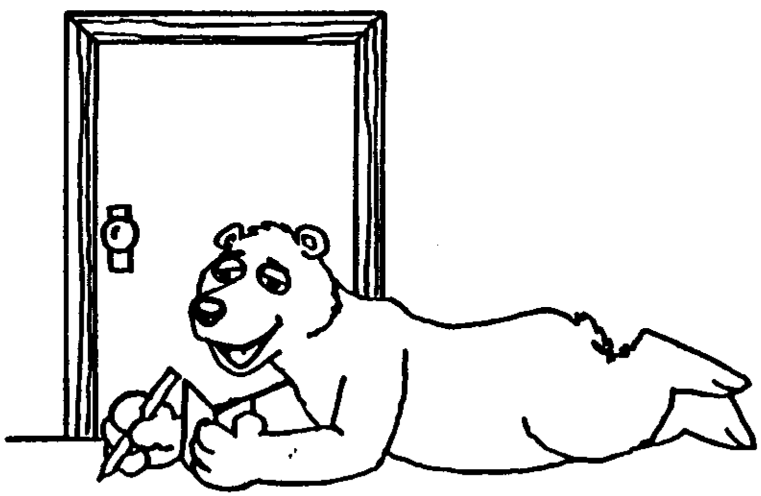
Our outside door frames are caulked.* ___ YES ___ NO

*CAULKING is a gummy material used to fill cracks around doors and windows.

The condition of the caulking is:

good ________ in need of repair ________

2-55



WINDOWS

There are ______ windows in my house.
NUMBER

My windows have:

single glass ___ double glass ___

storm windows ___

There is caulking around each window. ___ YES ___ NO

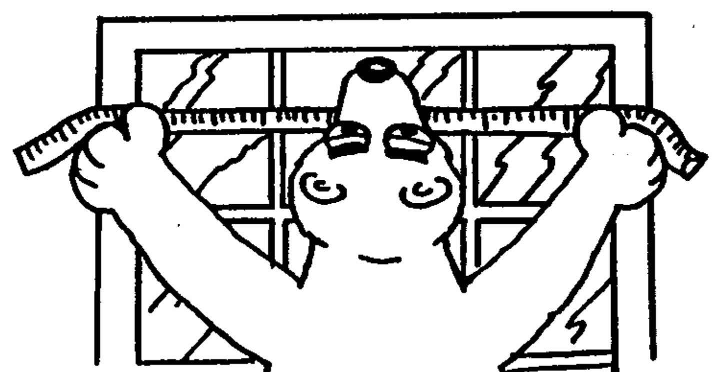
The condition of the caulking is:

good ________ in need of repair ________

I found weather stripping at each window opening. ___ YES ___ NO

The condition of the weather stripping is:

good ________ in need of repair ________



fold on dotted line

"IMPORTANT RULES"

MODERATOR, PLEASE READ THE FOLLOWING BEFORE EACH MATCH!!

Before we get started, I would like the coaches or representatives from each school to introduce themselves. Contestants, please give your name first and then test your buzzer by pushing the button. I must clear the system before another contestant will be able to ring in.

Next, I need to go over the basic competition rules with you.

1. There are two types of questions in this contest; **toss-ups** and **bonus** questions.

2. On toss-up questions, you MUST be **verbally** recognized by the Moderator before replying. If you respond before being **verbally** recognized, your team is automatically disqualified from answering the question. The question will then be offered as a toss-up question to the opposing team. Questions will not be re-read unless a team interrupts a question and answers incorrectly.

   In this match, I will identify you by saying either Team "A' or Team "B" and either Participant "1A" or "1B", "Captain A" or "Captain B", or "2A" or "2B" or "3A" or "3B".

3. On toss-up questions, there can be no talking among team members **ON EITHER TEAM** at **ANY** time. If talking occurs on the team that was initially recognized to answer the question, that team is disqualified from answering the question and the question is offered to the opposing team. If talking occurs or has occurred, on the opposing team, it too is disqualified from answering the question.

4. You may challenge the answer to a question or procedure but, **Challenges must be made before the moderator begins the next question**. All challenges must come from the team members who are actively competing. The alternate may not object.

5. If your team answers a toss-up question correctly it will have the chance to answer a **bonus** question. Teams may talk about the answer to a bonus question. You will have 20 seconds **AFTER** the Moderator finishes reading the question to begin your answer to the question. If you fail to begin your answer before the Judge/Timekeeper says "TIME," you have missed your bonus question. You will hear the Timekeeper say "5 SECONDS," when you have only 5 seconds left to begin your answer.

6. On the bonus question, only the team captain's answer will be accepted.

7. Matches will consist of two 8 minute halves and a two minute half-time when substitutions may be made.

8. Finally, I would like to remind everyone, that no one in the audience may communicate with participants (either verbally or non-verbally) during the match. In addition, if the judge believes a challenge was a direct result of audience commotion or communication, the challenge will be considered invalid.

No scores will be kept for these matches so relax and enjoy the contest.

Energy and Water Bowl Questions - Activity 26

Toss-up Q. 1. Multiple Choice. When water changes from a gas to a liquid this is called?

a. vaporization   b. condensation   c. evaporation   d. precipitation

Answer: b. condensation

Bonus Q. 1. Short Answer. Name the two elements that make up water.

Answer: hydrogen and oxygen

Toss-up Q.2. Multiple Choice. Which of the following is a type of energy?

a. water   b. electricity   c. hydrogen   d. a tennis ball

Answer: b. electricity

Bonus Q.2. Multiple Choice. A ball rolling down a hill is an example of which type of energy?

a. kinetic   b. potential   c. chemical   d. friction

Answer: a. kinetic

Toss-up Q.3. Multiple Choice. Batteries make electricity by ....

a. chemical reaction   b. making heat   c. giving light   d. none of these

Answer: a. chemical reaction

Bonus Q.3. Light bulb filaments need to have ....

a. oxygen   b. good conducting materials   c. high resistance to electricity
d. heavy materials to withstand heat

Answer: c. high resistance to electricity

Toss-up Q. 4. Multiple Choice. A watershed is mostly which part of the water cycle?

a. precipitation   b. evaporation   c. condensation   d. runoff

Answer: d. runoff

Bonus Q. 4. Multiple Choice. Transpiration relates to ....

a. rocks   b. plants   c. fish   d. rivers   Answer: b. plants

Toss-up Q. 5. Short Answer. Give one example of precipitation.

Answer: accept: rain, sleet, hail, snow, graupel, drizzle

Bonus Q. 5. Multiple Choice. Which of the following contains the most water on earth?

a. lakes b. rivers c. glaciers d. air

Answer: c. glaciers

Toss-up Q. 6. Multiple Choice. An example of potential energy would be?

a. a coiled spring b. a golf club c. a falling raindrop d. none of these

Answer: a. a coiled spring

Bonus Q. 6. Short Answer. One milliliter equals about how many drops of water?

Answer: accept 20-30 drops

Toss-up Q. 7. Short Answer. Where is most of the water on earth found?

Answer: the oceans

Bonus Q. 7. Multiple Choice. About what percent of the water on earth is contained in the oceans anc seas?

a. 50% b. 75% c. 90% d. 97%

Answer: d. 97%

Toss-up Q.8. Multiple Choice. A single molecule of water contains ....

a. twice as much hydrogen as oxygen b. twice as much oxygen as hydrogen
c. the same amount of hydrogen & oxygen d. none of the above

Answer: a. twice as much hydrogen as oxygen

Bonus Q.8. Short Answer. Does oxygen go to the positive or negative terminal when separating water into hydrogen and oxygen with electricity?

Answer: positive terminal

Toss-up Q.9. Multiple Choice. There are many ways to generate electricity, which of the following is not a common way to make electricity?

a. wind generators b. solar cells c. hydroelectric dams d. ice generators

Answer: d. ice generators

Bonus Q.9. Multiple Choice. In the region we live in, which of the following produces the most electricity?

a. hydro power b. nuclear power c. solar power d. wind power

Answer: a. hydro power

Toss-up Q.10. Water is found on earth in which 3 phases?

a. gas, vapor, condensed b. solid, liquid, gas c. snow, rain, sleet d. none of these

Answer: b. solid, liquid, gas

Bonus Q.10. Short Answer. In the atmosphere, which of the 3 water phases can be present?

Answer: solid, liquid, gas

Toss-up Q.11. Multiple Choice. Three rivers that flow into the Columbia River are?

a. Klamath, Chinook, Clatsop
b. John Day, Snake, Clearwater
c. Mississippi, Glacier, Idaho
d. Willamette, Sacramento, Trask

Answer: b. John Day, Snake, Clearwater

Bonus Q.11. Short Answer. Name the river the flows through the middle of downtown Portland.

Answer: Willamette River

Toss-up Q.12. Multiple Choice. If there are about 25 drops of water to a milliliter, how many drops would a 10 milliliter container hold?

a. 100 b. 150 c. 200 d. 250

Answer: d. 250

Bonus Q.12. Multiple Choice. About how long would it take to fill a 5 milliliter container with water if you added 1 drop every second?

a. 2 minutes b. 4 minutes c. 6 minutes d. 8 minutes

Answer: a. 2 minutes

Toss-up Q.13. Multiple Choice. Which of the following contains the least water on earth?

a. ice caps b. the ground c. lakes d. the atmosphere

Answer: d. the atmosphere

Bonus Q.13. Short Answer. Evaporation, condensation, and precipitation are all part of the ....

Answer: Water Cycle

Toss-up Q.14. Multiple Choice. If something had a pH the same as water it would be about?

a. 3 b. 5 c. 7 d. 9

Answer: c. 7

Bonus Q.14. Short Answer. Next to oceans on earth, what is the next largest source of water?

Answer: Ice caps and Glaciers

Toss-up Q.15. Multiple Choice. Which kind of energy does your body run on primarily?

a. electrical energy b. nuclear energy c. solar energy d. chemical energy

Answer: d. chemical energy

Bonus Q.15. Short Answer. What is the primary source of the chemical energy that runs our bodies?

Answer: Food or Nourishment

Toss-up Q.16. Multiple Choice. What is the difference in height between the water behind Bonneville Dam and that in front of it?

a. 60 feet b. 70 feet c. 80 feet d. 90 feet

Answer: a. 60 feet

Bonus Q. 16. Multiple Choice. When was Bonneville Dam built?

a. 1948 b. 1963 c. 1933 d. 1981

Answer: c. 1933

Toss-up Q.17. Multiple Choice. Which watershed does Portland get its water from?

a. Columbia b. Willamette c. Bald Peak d. Bull Run

Answer: d. Bull Run

Bonus Q.17. Short Answer. What force moves water from the Bull Run watershed to the reservoirs in Portland?

Answer: gravity

Toss-up Q. 18. Multiple Choice. About how many eggs does a female salmon lay?

a. 200 b. 500 c. 5000 d. 15000

Answer: c. 5000

Bonus Q. 18. Short Answer: Does warm water or cold water hold more dissolved oxygen?

Answer: cold water

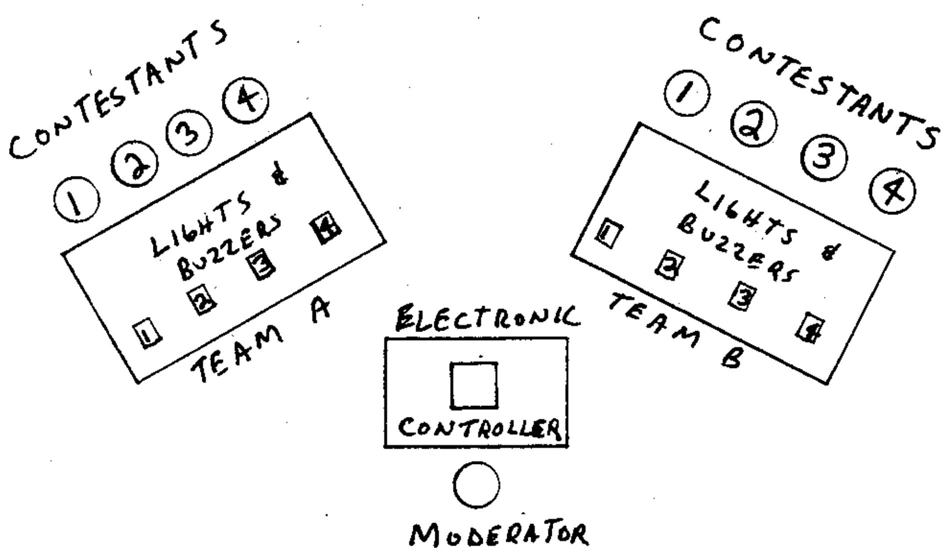
Activity 26 **Energy and Water Bowl**

Skills: Application, Listening, Reporting, Small Group Work, Synthesis

Objective(s) Students will be able to demonstrate comprehension of the nature of energy and the water cycle by responding quickly to evaluative questions.

Materials: 4 Electronic Response Systems, 4 Question Sets, Prizes

Procedure: Set-up the electronic response systems for four contests between teams of four students (as shown below). Divide students into 8 teams of 4 and explain to them that they are going to be playing a Jeopardy type game with questions about what they learned in camp the past few days. Teachers or counselors read the toss-up and bonus questions for contestants. Run the contests for 20 minutes or until all of the questions have been asked. When completed, tally the scores and present prizes to the students. Question sets and rules are located in Teacher's Materials section.



Conclusion: Award All Teams for Their Performance

Native American Legend Story Telling Continued (select the next story to read to students)

Field Trip Reminder: Remind students that the field trip bus departs at 9:00 a.m. the next day

3:00 p.m. Camp Ends for Students

Day 9 **Teacher's Guide**

9:00 a.m. Breakfast

9:10 a.m. Guestimation Activity

Hold up a recyclable aluminum can and ask students to estimate how many watts of electricity it takes to produce one such can (~360 watts). Explain that when we recycle our aluminum cans, we save a lot of energy and help our environment.

Safety Demonstration **PGE's Hazard Hamlet**

A PGE representative presents common indoor and outdoor electrical hazards. A live display shows hazards present in 12 common situations. The portable unit captivates most students.

Activity 31 **Electrical Safety Skits**

Skills: Application, Public Speaking, Visualization, Small Group Work, Invention

Objective(s): Students will be able to demonstrate proper safety procedures necessary for using electricity by creating a skit to present to the class.

Materials: Construction Paper, Marking Pens, Glue, Tape, Video Equipment, Electrical Appliances and Cords

Procedure: Begin activity by reviewing safety precautions to use when working with electricity. Provide a list of safety rules to students to use for reference (reproducible master can be found in Teacher's Materials section). Ask students to put together a 3-5 minute skit that demonstrates one or more of the safety rules for using electricity. Explain that groups will have 15-20 minutes to prepare their skits. Each skit will be videotaped to replay during the end of camp celebration that afternoon.

Ideas:

1. Have a moderator direct questions to an "expert" panel
2. A skit where students are involved in an electrical accident
3. Groups might contrast safe and unsafe practices
4. Groups could use a quiz show format asking questions of contestants
5. A simulated news interview at the scene of an electrical accident
6. Demonstrate how to use different devices safely

Conclusion: Bring closure to this activity by playing back the videotape and reviewing the safety procedures presented by each group.

Activity 31 **Electrical Safety Skit** **Student Activity Sheet** ________
(your name)

Background: In our homes, neighborhoods, and schools we all use electricity. If you use electricity properly it is completely safe and there is no reason to be afraid of it. Improper use, however, can be deadly. If you plug in too many appliances to an extension cord, for example, the wire will heat up and a fire could result. Read the key electrical safety rules below.

Key Electrical Safety Rules

1. Be careful not to plug in too many things into one outlet.
2. If your lights dim or fuses pop when an appliance goes on, you are overloading a circuit which may cause a fire.
3. Never wash electrical appliances while they are plugged in.
4. Don't use frayed or broken electrical cords.
5. Make sure that when you plug something in a wet area that it is grounded.
6. Be sure that electrical cords do not touch pipes, heat ducts, nails, hooks or hot appliances.
7. Never operate electrical tools outside when it is wet.
8. Overhead electrical wires should not touch trees, antennas, or parts of your house.
9. Never climb a tree without checking for wires first.
10. Do not fly kites, cast lines, lean poles, or throw ropes near overhead lines.
11. After a storm be careful not to touch fallen wires.

Vocabulary: Circuit, Short, Grounding, Conductor, Outlet, UL Approved

Directions: **Step 1**. Look at the key safety rules for the safe use of electricity. In this activity you will work with a group to make up your own skit that demonstrates one or more of the safety rules listed above.

1. Ask questions of an "expert" panel.
2. Have each member demonstrate a different safety rule.
3. Groups might act out safe or unsafe practices.
4. Use a quiz show format asking questions of contestants.
5. A simulated news interview at the scene of an electrical accident.
6. Demonstrate how to use different devices safely.

Step 2. Practice your skit.

Step 3. Show time! Present your skit for the camera.

Be creative and have fun with your skit!